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VOL. CLIII.—No. 3988] LONDON: FRIDAY EVENING, JUNE 17, 1932 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

MANCHESTER MUNICIPAL
COLLEGE OF TECHNOLOGY.

Principal:
B. MOUAT JONES, D.S.O., M.A. (Oxford).

UNIVERSITY OF MANCHESTER.
(Faculty of Technology.)

DEGREE COURSES IN TECHNOLOGY.

The Prospectus gives particulars of the Courses leading to the Manchester University Degrees (B.Sc. Tech., M.Sc. Tech., and Ph.D.) and Certificates in the Faculty of Technology, in the following Departments:
MECHANICAL ENGINEERING.
(Prof. Dempster Smith, M.B.E., M.Sc. Tech., M.I.M.E.)
ELECTRICAL ENGINEERING.
(Prof. Miles Walker, M.A., D.Sc., M.I.E.E., F.R.S.)
MUNICIPAL ENGINEERING.
(G. S. Coleman, D.Sc. Eng., A.M. Inst. C.E., A.M. Inst. M. and Cy. E., F.R. San. I.)
APPLIED CHEMISTRY, including General Chemical Technology, Metallurgy and Assaying, Fermentation Processes (including Brewing), Electrochemistry, Photography, Colouring Matters, Foodstuffs and Fuels.
(Prof. James Kenner, D.Sc., Ph.D., F.R.S.)
TEXTILE CHEMISTRY (Bleaching, Dyeing, Printing and Finishing), Paper Manufacture.
(F. Scholefield, M.Sc., F.I.C., F.T.I.)
TEXTILE TECHNOLOGY.
(Prof. W. E. Morton, M.Sc. Tech., F.T.I.)
BUILDING.
(W. B. McKay, M.I. Struct. E., M.R. San. I.)
INDUSTRIAL ADMINISTRATION (Post-Graduate Certificate Course).
(K. G. Fenelon, M.A., Ph.D.)
Prospectus will be forwarded free on application to the REGISTRAR, College of Technology, Manchester. 8588

County Borough of Swansea.
MAIN DRAINAGE SCHEME.
CONTRACT No. 9.

			Yds.
SECTION A	(BRYNMILL TO HAFOD)		4,111
"	B	(HAFOD TO MORRISTON)	4,902
"	C	(MORRISTON TO CLYDACH)	3,202
			12,215

WORKS FROM BRYNMILL TO CLYDACH.
(UNEMPLOYMENT RELIEF WORKS.)

The Corporation invite TENDERS for the CONSTRUCTION of approximately 7 Miles of MAIN TRUNK SEWER (principally in Brick and Concrete), of which about 5 Miles will be in TUNNEL and 2 Miles in OPEN CUTTING; together with Storm Water Drains, Culverts, Manholes, Overflows, Chambers, Stream Diversion, and other incidental works, as briefly stated below:—

Yds.	Dia.	Description.
		SECTION A.
506 ..	3ft. 6in. ..	Cast Iron Pipe Sewer in trench haunched in concrete
928 ..	5ft. 6in. ..	Brick and Concrete Sewer in trench
184 ..	5ft. 3in. ..	Ditto. Ditto.
1004 ..	5ft. 3in. ..	Ditto. in TUNNEL
1168 ..	4ft. 9in. ..	Ditto. Ditto.
98 ..	4ft. 6in. ..	Ditto. Ditto.
323 ..	4ft. 0in. ..	Ditto. Ditto.
4111		
		also
490 ..	1ft. 6in. ..	Concrete pipe S.W.D. bedded on concrete
480 ..	2ft. 6in. ..	Ditto, surrounded with concrete
30 ..	2ft. 3in. ..	Ditto. Ditto.
5111 ..	41 No. ..	Brick Manholes and Overflow Chambers, and various incidental works
		SECTION B.
3800 ..	3ft. 6in. ..	Brick and Concrete Sewer in TUNNEL
1053 ..	3ft. 0in. ..	Ditto. Ditto.
100 ..	5ft. 0in. ..	Brick and Concrete Culvert, Stream Diversion in TUNNEL
17 ..	1ft. 9in. ..	Cast Iron Pipe Sewer in Concrete in TUNNEL
32 ..	3ft. by 2ft. ..	Brick and Concrete Sewer in TUNNEL
33 ..	1ft. 6in. ..	Cast Iron Pipe S.W.O. Culvert in TUNNEL
5035 ..	44 No. ..	Brick Manholes and Overflow Chambers and various incidental works
		SECTION C.
1614 ..	2ft. 3in. ..	Brick and Concrete Sewer in trench
496 ..	2ft. 3in. ..	Ditto, in TUNNEL
273 ..	2ft. 3in. ..	Cast Iron Pipe Sewer in trench
191 ..	2ft. 0in. ..	Brick and Concrete Sewer in trench
628 ..	2ft. 0in. ..	Ditto, in TUNNEL
40 ..	1ft. 3in. ..	Concrete Pipe S.W.O. Culvert in TUNNEL
3242 ..	29 No. ..	Brick Manholes and Overflow Chambers and various incidental works

The Contractor shall submit SEPARATE TENDERS for one or more of the SECTIONS A, B, and C, comprised in Contract No. 9.

The Corporation in their absolute discretion may accept:—
(a) One Tender comprising the three Sections A, B, and C, or, alternatively,
(b) A combination of any two Tenders of any one Contractor for any two Sections, or, alternatively,
(c) A Tender of any Contractor for any one Section.

The whole of the works are UNEMPLOYMENT RELIEF WORKS, and will be subject to certain conditions laid down by the Government Unemployment Grants Committee.

On and after the 15th June, 1932, plans may be seen and specification, form of Tender, bills of quantities, and set of selected drawings obtained at the office of the Chief Engineer, Mr. J. Richard Heath, Guildhall, Swansea, on deposit of Twenty Pounds, which will be returned on receipt of a bona fide Tender (not subsequently withdrawn), together with the specification, bills of quantities and set of drawings, all of which documents are the property of the Corporation, to whom they shall be returned on demand.

NOTE.—Only a limited number of sets of drawings are available, and Contractors should therefore make early application for same.

The documents and Tenders, which shall be enclosed in a sealed registered envelope, endorsed "SWANSEA MAIN DRAINAGE, CONTRACT No. 9," must be received by the undersigned not later than Twelve Noon on the 15th July, 1932.

The lowest or any Tender will not necessarily be accepted.

H. L. LANG-COATH,
Town Clerk.

Guildhall,
Swansea,
June, 1932. 8613

The Engineer

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PUBLIC NOTICES.

James Watt Research Fellowship
IN MECHANICAL ENGINEERING.

APPLICATIONS are INVITED for the JAMES WATT RESEARCH FELLOWSHIP in MECHANICAL ENGINEERING and should be submitted to the undersigned not later than 11th July, 1932.

The Fellowship has at present an annual value of about £250 and is tenable in the first instance for one year, but may be renewed for a further period. Applicants should hold an Honours Degree in Engineering of a British University and should preferably have had at least one year's experience of post-graduate research; they will be expected to possess aptitude for experimental research and to assist the Professor of Mechanical Engineering at the University of Birmingham in research work.

D. J. CAMERON,
Registrar,
8634 University of Birmingham.

The Worshipful Company of
ARMOURERS AND BRASIERS IN THE CITY OF LONDON.

RESEARCH FELLOWSHIP IN AERONAUTICS.

The Armourers' and Brasiers' Company are offering a FELLOWSHIP of £300 per annum, for two years, for RESEARCH in AERONAUTICS.

Applications must be sent before the 1st July, 1932, to the CLERK, Armourers' Hall, 81, Coleman-street, London, E.C. 2 from whom forms of application and particulars of the Fellowship can be obtained. 8632

University of London.

The Senate invite APPLICATIONS for the UNIVERSITY READERSHIP in ELECTRICAL ENGINEERING (TELEGRAPHY and TELEPHONY), tenable at the Imperial College—City and Guilds College. Salary, £600 a year.—Applications (12 copies) must be received not later than first post on 1st July, 1932, by the ACADEMIC REGISTRAR, University of London, S.W. 7, from whom further particulars may be obtained: 8654

The Civil Engineers Appointments Board,
8, Princes-street, Westminster, S.W. 1, acting under annual licence from the London County Council, invites INQUIRIES from EMPLOYERS SEEKING the SERVICES of PROFESSIONAL ENGINEERS, either as Assistants or in more responsible positions.

All those whose names are accepted for entry in the Board's Register for employment possess qualifications which have been attested by means of scientific examinations, practical training, and experience. P2183

PUBLIC NOTICES.

Leith Dock Commission.

TENDERS
FOR
NEW REINFORCED CONCRETE GRAIN WAREHOUSE.

THE COMMISSIONERS FOR THE HARBOUR AND DOCKS OF LEITH are prepared to receive, from CONTRACTORS WHO HAVE HAD EXPERIENCE IN SIMILAR WORK, TENDERS for the provision and erection of a NEW GRAIN WAREHOUSE AND SILOS of Reinforced Concrete, the building to occupy an area of about 170 feet by 140 feet on ground adjoining the East Quay of the Imperial Dock, Leith, the highest part of the building being about 150 feet above quay level.

On and after 15th June, copies of the Description of Works, Conditions of Contract, Specification, Bill of Quantities, General Drawings, and Forms of Schedule of Prices, and Tender may be obtained from ALFRED H. ROBERTS, Esq., M. Inst. C.E., Superintendent and Engineer, at the address undernoted, on payment of a deposit of Fifteen Pounds. An additional copy of the Specification and Schedules may be obtained upon a further deposit of Two Pounds. These deposits will be returned after the receipt of a bona fide Tender and on the return of all the documents.

The Drawings, showing Steelwork and other details, may, by appointment, be examined at the Engineer's Office here.

The Commissioners do not bind themselves to accept the lowest or any Tender.

Tenders, on the prescribed form, enclosed in sealed envelopes and endorsed on the outside "Tender for Grain Warehouse," must be delivered not later than 30th June, 1932, to the Subscriber.

C. C. LEARMONTH,
Clerk to the Commissioners.
Dock Offices, Leith, Edinburgh, 6,
10th June, 1932. 8633

Norton Power Station, Malton,
YORKSHIRE.

TENDERS are INVITED for the PURCHASE of the GENERATING PLANT at the above Station, consisting of:—
Gas Engines, Oil Engines, B.W.E.M. Generators, Balancers, Boosters, Air Compressor, Switches, Switch Panels, &c.

Arrangements will be made for prospective purchasers to inspect the plant, and copies of the full schedule will be forwarded on request, which, in the first instance, must be made in writing to:—
JOINT SECRETARY,
The Northern Counties Electricity Supply Co., Ltd.,
8635 Carliol House, Newcastle-upon-Tyne.

PUBLIC NOTICES.

County Borough of Swansea.
ELECTRICITY DEPARTMENT.
GENERATING PLANT FOR POWER STATION AT TIR JOHN NORTH.

The Corporation invite TENDERS for the SUPPLY, DELIVERY, and ERECTION of the above and other incidental works. The works are unemployment relief works and will be subject to conditions laid down by the Government Unemployment Grants Committee. On and after 20th June, 1932, plans may be seen and general conditions, specification, and form of Tender, in duplicate, obtained at the office of the Consulting Engineers, Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W. 1, on deposit of Five Guineas, which will be returned on receipt of a bona fide Tender (not subsequently withdrawn).

Additional copies may be obtained on receipt of a fee of £1 1s. for each copy, which will not be returnable.

Sealed Tenders must be received by the undersigned not later than Twelve Noon on the 3rd August, 1932. The lowest or any Tender will not necessarily be accepted.

H. L. LANG-COATH,
Town Clerk.
The Guildhall, Swansea,
16th June, 1932. 8639

Metropolitan Borough of
ISLINGTON.

The Electricity and Lighting Committee of the Council invite TENDERS for the SUPPLY and ERECTION of STRUCTURAL STEEL WORK to strengthen an existing Structure at the Electricity Power-house, Eden-grove, Holloway, N. 7.

Drawings, specification, general conditions, and form of Tender may be obtained from the Consulting Engineer, Ewart S. Andrews, B.Sc., M.I.C.E., &c., at 201-6, Bank Chambers, 329, High Holborn, W.C. 1, on payment of Two Guineas, which will be returned upon receipt of a bona fide Tender.

Tenders, endorsed "Structural Steel Work," must be delivered to the Town Clerk not later than Noon on Wednesday, 29th of June.

The Council do not undertake to accept the lowest or any Tender.

By Order,
E. H. JERMAN,
Town Clerk.
Town Hall, Upper-street, N. 1.
6th June, 1932. 8636

Railways.
LOCOMOTIVES, CARRIAGES, AND WAGONS (METRE GAUGE).

The following are REQUIRED for the Gaekwar's Baroda State Railway:—
(a) LOCOMOTIVES, 4-6-0 type.
(b) CARRIAGE UNDERFRAMES and WAGONS.

Specifications and Tender forms can be obtained from Rendel, Palmer and Tritton, Consulting Engineers, 55, Broadway, Westminster, S.W. 1, on payment of 10s. 6d. per specification, which will NOT be returnable.

Tenders IN DUPLICATE should be submitted to the CONSULTING ENGINEERS at the above address not later than NOON on 12th July, 1932. 8648

Stockport Corporation Water-Works.
GOYT VALLEY SUPPLY—CONTRACT NO. 5.
TRUNK MAINS, HIGH-LEVEL SERVICE TANK AND INTAKES, VALVES, PIPES, IRONWORK, &c.

The Waterworks Committee invite TENDERS for the SUPPLY of VALVES, PIPES, IRONWORK, &c., in connection with the above works.

The drawings may be seen and specification, form of Tender, and schedule obtained on application to Messrs. G. R. Hill and Sons (Manchester), 40, Kennedy-street, Manchester, upon receipt of a cheque for Two Guineas, which will be returned to the applicant provided that he shall have sent in a bona fide Tender and shall have not withdrawn the same, and shall have returned the drawings and documents lent to him.

A limited number of copies of the drawings are available, and will be lent to persons tendering, in priority of application, upon the receipt of the sum of One Guinea, which sum will not be returned.

Sealed Tenders, endorsed "Goyt Valley Supply, Contract No. 5," and addressed to the "Chairman of the Waterworks Committee," must be delivered at the Waterworks Offices, Town Hall, Stockport, not later than the 5th day of July, 1932.

The Committee do not bind themselves to accept the lowest or any Tender.

FRANK KNOWLES,
Town Clerk.
Town Hall, Stockport,
14th June, 1932. 8642

The Madras and Southern
MAHRATTA RAILWAY COMPANY, Ltd., invite TENDERS for:—
147 Pairs WHEELS and AXLES for CARRIAGES and WAGONS—M.G.

Tenders are due in on Tuesday, 28th June, 1932, by 2.00 p.m. Tender forms are obtainable at address below: fee, ONE GUINEA each, WHICH WILL NOT BE RETURNED.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices:
25, Buckingham Palace-road,
Westminster, S.W. 1. 8647

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The Engineer

Annual Subscription Rates

(including postal charges).

Le prix de l'abonnement est accepté en livres sterling, ou dans la monnaie du pays d'origine au cours du change au moment de la commande.

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Serán aceptados los abonos en moneda esterlina o su equivalente calculado en la moneda del páis de origen al cambio efectivo a la fecha de ponérse el pedido.

BRITISH ISLES ..	£3	5	0	
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SHANGHAI: Kelly and Walsh, Ltd.

DENMARK .. Teknisk Presse Bureau, Ourvsgade 34, Copenhagen.

EGYPT .. .. CAIRO: Express Book and Stationery Store, 9, Chareh Maghrabi

FINLAND .. HELSINGFORS: Akademiska Bokhandeln, Alexandersgatan, 7

FRANCE .. .. PARIS: Boyveau and Chevi let, Rue de la Banque, 22
PARIS: Librarie Berger-Leverault, 229, Bld. St. Germain
PARIS: Brentano's, 37, Av. de l'Opera
PARIS: Dunod, 92, Rue Bonaparte
PARIS: W. H. Smith and Son, 248, Rue de Rivoli

GERMANY .. BERLIN - LICHTERFELDE - WEST: H. Hermanns, Dahlemer Strasse, 64 A
LEIPZIG: K. W. Hiersemann, Konigstrasse 29

HOLLAND .. ROTTERDAM: Hector's Boekhandel, Noordblank 59
ROTTERDAM: Techn. Boekhandel, "Plan C," Gelderschestraat 4

INDIA .. .. BOMBAY: Thacker and Co., Ltd.
CALCUTTA: Thacker, Spink and Co.

ITALY .. .. MILAN: Ulrico Hoepli
ROME: Maglioni and Strini, 307, Corso
ROME: Fratelli Treves, Corso Umberto 1, 174
ROME: Fratelli Bocca
TURIN: Rosenberg and Sellier, v. Maria Vittoria 18, and their Branches at Naples and Rome

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NEW ZEALAND AUCKLAND: Whitcombe and Tombs, Ltd.
Gordon & Gotch, Ltd. All Branches
NAPIER: J. Wilson Craig and Co.

RUSSIA .. .. LENINGRAD: Mezhdunarodnaya Kniga, Prospect Volodarsky, 53A
MOSCOW: "Litisdat," Kousnetsky Most, 515

STRAITS SETTLEMENTS—SINGAPORE: Kelly and Walsh, Ltd.

SWEDEN .. .. STOCKHOLM: A/B Wennergrens Journal-expedition, Stockholm 1
STOCKHOLM: A/B C. E. Fritzes Kungl., Hofbokhandel, Fredsgatan, 2

SWITZERLAND BERNE: Joh. William De Groot Laupenstr., 5
ZURICH: Rosa Leibowicz, 4, Ankerstr.

UNITED STATES OF AMERICA International News Co., 131, Varick-street, New York, N.Y., and all Branches

Entered as second-class matter at the P. st Office, New York, N.Y., December 12th, 1896, under the Act of March 3rd, 1879 (Section 397, P.L. & R.)

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

"THE METALLURGIST."

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

ADVERTISEMENTS.

The charge for Classified Advertisements is 1/- per line up to one inch—minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication).

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

Postal Address, 28, Essex-street, Strand, London, W.C. 2. Teleg. Address, "Engineer Newspaper, Estrand, London." Tel., Central 6565 (8 Lines).

PUBLIC NOTICES

The Chinese Government Purchasing Commission.

The Commission is prepared to receive TENDERS from British manufacturers for the SUPPLY of :—
(a) 9909 Metric Tons of 43 kg./m. RAILS and 584 Metric Tons of FISHPLATES.
(b) 49 Metric Tons of FISHBOLTS, 453 Metric Tons of SCREWSPIKES, 56,620 ANTI-CREEP DEVICES, and 94,340 SPRING WASHERS.

Tender forms, &c., can be obtained on and after Friday, June 17th, at the offices of the Consulting Engineers, Messrs. Sandberg, 40, Grosvenor-gardens, London, S.W. 1.

Fees of £1 10s. and £1, which are not returnable, will be charged for each set of documents of (a) and (b) respectively. 8646

County Borough of Southampton.

APPOINTMENT OF WATERWORKS ENGINEER.

The Corporation invite APPLICATIONS for the POSITION of WATERWORKS ENGINEER and MANAGER of their Waterworks and Water Undertaking, from properly qualified Engineers not exceeding 40 years of age and fully experienced in the design, construction, and maintenance of modern waterworks, and the management of large public water undertakings.

The gentleman appointed will be required to advise the Council upon all matters relating to the water supply of their area of supply, to perform all the duties devolving on him under the Public Health and Local Acts, to devote his whole time to the duties of the office, and to engage in no other business or occupation. He will hold office during the pleasure of the Council. Salary £1100 per annum, subject to temporary abatement (at present £55 per annum). A car allowance of £200 per annum will also be paid.

The Local Government and Other Officers' Superannuation Act, 1922, will be applicable to the appointment and contributions to the Superannuation Fund will be deducted from the salary. The selected candidate will be required to pass a satisfactory medical examination.

Applications, stating previous and present appointments, qualifications and any other relevant particulars, and accompanied by copies of not more than three recent testimonials, and the names and addresses of three referees, must be addressed to the Town Clerk, endorsed "Appointment of Waterworks Engineer" and delivered at the Town Clerk's office on or before 30th June, 1932.

Canvassing is prohibited and will disqualify.

E. RONALD H. MEGGESON,
Town Clerk.

Town Clerk's Office,
Municipal Offices, Southampton.
15th June, 1932. 8637

Metropolitan Borough of Poplar.

ELECTRICITY DEPARTMENT.
ASSISTANT GENERAL MANAGER AND DEPUTY ENGINEER.

The Council of the Metropolitan Borough of Poplar invite APPLICATIONS from persons fully qualified for the POSITION of ASSISTANT GENERAL MANAGER and DEPUTY ENGINEER in its Electricity Department.

Applicants must have had first-class training and experience in Electricity Supply in all its branches and be capable of taking full control of the Department in the absence of the General Manager and Chief Engineer.

The salary will be at the rate of £900 per annum. The successful candidate will be required to pass a medical examination and to contribute to the Council's Superannuation Fund.

Forms of application may be obtained from my office and must be returned, together with a letter of application and copies of three recent testimonials, in envelope endorsed "Deputy Engineer," not later than Saturday, 2nd July next.

Canvassing members or officers of the Council in any form will disqualify.

H. E. DENNIS,
Town Clerk.

Council Offices,
117, High-street, Poplar, E. 14.
14th June, 1932. 8641

SITUATIONS OPEN.

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

TO ADVERTISERS UNDER BOX NUMBERS IN THIS CLASSIFICATION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge, and co-operation is asked for.

WANTED, a WORKS MAN, Experienced in Dealing with the progressing of diverse orders. Factory employs 1000. Engineering knowledge useful, but organising aptitude and actual experience in modern progress routing indispensable. Full details, age, wages, &c.—Address, P2513, The Engineer Office. P2513 A

WANTED, Young ENGINEER, with Thorough Mechanical Knowledge and thorough knowledge of Coppersmith's Work. Good knowledge spoken French essential. Reply in writing, giving particulars education, school, university, previous employment, and type of work done.—Address, P2508, The Engineer Office. P2508 A

LONDON PUMP COMPANY REQUIRE Well-introduced REPRESENTATIVE ENGINEER, resident North-East Coast, on commission basis. Give details of other agencies.—Address, 8650, The Engineer Office. 8650 A

TECHNICAL SALESMAN (Age 35 to 45) REQUIRED by large Engineering Firm; thorough knowledge of Complete Pumping Installations of all descriptions essential.—Address, giving full particulars and salary required, 8640, The Engineer Office. 8640 A

THOROUGHLY Practical or Technical ENGINEER, Executive Position; Hydraulic Experience useful; required for development work. State experience and full details.—Address, 8653, The Engineer Office. 8653 A

SITUATIONS OPEN (continued)

TWO or THREE VACANCIES in Design Office of Firm of Automobile Builders. Automobile Design experience essential, college training preferred. Full particulars of experience, age, and salary required.
Address, P2507, The Engineer Office. P2507 A

WANTED, Thoroughly Competent and Experienced WORKING FOREMAN, to Take Entire Charge of Small Millwrighting and General Engineering Shops.—Address, P2511, The Engineer Office. P2511 A

SITUATIONS WANTED.

A HIGHLY QUALIFIED ENGINEER, with both civil and mechanical experience of waterworks, sewage disposal, irrigation, drainage, water power, and harbour works, with knowledge of conditions in India, Africa, and on the Continent, DESIRES an APPOINTMENT, preferably with London headquarters, where his proved initiative and long experience can be fully utilised. Highest credentials given.
Address, P8602, The Engineer Office. P8602 B

ACCOUNTANT (Qualified) DESIRES RESPONSIBLE POSITION; sound knowledge and experience, shipbuilding and engineering costing and accounts; has laid down and worked modern systems (on controlling account principle) linked up with financial books; organiser and disciplinarian.—Address, P2523, The Engineer Office. P2523 B

AN ENERGETIC MAN, of the Highest Integrity, Age just 40 years, REQUIRES a POSITION OF TRUST.
Keen Buyer, good general engineering and installation draughtsman; ten years' executive experience; six years as chief designer in charge of jig and tool, &c., drawing-office; also four years in the capacity of manager and engineer.
Well acquainted with office and works organisation and administration, also accustomed to the engagement and control of labour, theoretical and practical, th ser.
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Patents.

ACCORDING to the forty-ninth report of the Comptroller-General of Patents, Designs, and Trade Marks, the number of applications for patents in 1931 at 36,117 shows a drop relative to the preceding year of more than 3000. The decrease is especially marked in the case of chemical inventions, but it is considered by no means certain that this fall is indicative of any slackening in the rate of progress of chemical research. In the electrical industries the establishment of the "grid" system is still responsible for much invention. Switchgears are being devised in which air or vapour blasts are used for quenching the arc, and oil is either dispensed with or employed only in small quantities. In connection with the conversion and transformation of electricity there is a growing tendency to replace moving control elements by static devices involving improvements connected with dry-surface rectifiers, thermionic valves, mercury arc, and similar discharge apparatus. There is a marked increase in the number of inventions concerned with telegraph exchange systems, employing the technique of automatic telephony and of typewriting telegraphs for use therewith. In television attention is being directed to the replacement of apertured scanning discs by other means, such as reflectors, moving arcs, and cathode rays. On the mechanical side the suspension problems of heavy vehicles—particularly six-wheelers—have received much attention, and there is still much activity in connection with flexible power transmission systems and devices for rendering gear changing automatic.

Waterloo Bridge.

IN a Journal note of June 3rd we outlined the proceedings in the House of Commons which led to the deletion of the item in the London County Council's Money Bill which provided for raising the first part of the cost of the demolition of Waterloo Bridge and the erection of a new bridge. At a meeting of the London County Council, Sir Oscar Warburg, on Tuesday last, June 14th, submitted the report of the Parliamentary Committee. In doing so he said that in view of the discussions on the future of Waterloo Bridge which were now taking place with the Government, he thought it would be better that he should make no comment. The Council therefore received the report without any debate.

The Late Professor J. W. Gregory.

IT was with keen regret that we read on Tuesday a report received from Lima that Professor John Walter Gregory had lost his life by drowning in the river Urubamba, near Mega Toni Falls, in Peru. To engineers Professor Gregory will be best remembered by the delightful and instructive "Thomas Hawksley" Lecture on "The Machinery of the Earth" which he delivered before the Institution of Mechanical Engineers in November, 1930. He had left England early this year as leader of a geological expedition to investigate a portion of the coastal deserts and mountains of Peru. His intention was to cross one of the least-known parts of the Andes and to continue the journey by canoe down one of the headstreams of the Amazon. Professor Gregory was in his sixty-ninth year. He was educated at Stepney Grammar School, and was at the outset of his career associated with his father in the wool trade. Subsequently he qualified for an assistantship in the Geological Department of the British Museum, and thereafter he devoted himself to scientific pursuits. In 1900 he left London to take up the post of Professor of Geology and Mining at the University of Melbourne, and in 1904 he returned to occupy the Chair of Geology at Glasgow University. From that post he retired three years ago, but with the termination of his professorial duties his activities as a geologist were far from being over. He won fame not only as a geologist, but as a geographer, an explorer, and a social economist. Altogether he is said to have written twenty books and 300 papers. In his journeyings he visited East Africa, Spitzbergen, Central Australia, and Chinese Tibet. He was a Fellow of the Royal Society, a Past-president of the Geological Society, and a Past-president of the Royal Geographical Society. To a large number of past students his memory of them and his ever kindly manner will be cherished as an example and inspiration. He exhibited in a remarkable degree the humility and the humanity which so often accompanies, which seems in fact to be a natural consequence of, the attainment of exceptional scientific knowledge.

The Road Transport League.

A NEW organisation, known as the Road Transport League, has been formed as the result of a unanimous resolution passed by a large number of representative operators in all branches of road motor transport. The League has as its object the encouragement of the free development of road transport, unimpeded by excessive taxation, artificial restrictions, or injurious legislation. It will attempt to mobilise all who are interested in or dependent for their livelihood upon road transport, enlisting them as volunteer workers. The signatories will, in their turn, endeavour to educate public opinion in favour of the object of the League and to counteract the effect of hostile propaganda conducted in the interests of other forms of transport. Entry to the League is open, without payment, to all who have the main object of the League at heart. Every signatory will be expected to assist the work, as opportunity may arise, in any or all of the following ways:—By keeping the League informed of any happenings or prospective happenings in his neighbourhood likely to injure road transport interests; by doing his best to counteract such moves by letter or speech; by communicating to the League any proposals or ideas that seem likely to be useful as providing means for justifiable attack upon antagonists; by seriously considering the advisability of joining the association or society best suited, in view of the particular nature of his business, to give him valuable service; by endeavouring to support the activities of the League; in the event of parliamentary or local elections, by assuring himself that his prospective representatives are pledged to take a favourable course in respect of the objects for which the League stands; by reporting interesting local happenings to the League as a guide or warning applicable to possible events elsewhere.

The National Power Scheme.

ACCORDING to a statement issued by the Central Electricity Board on Friday last, June 10th, good progress continues to be made with the national power scheme. By the end of May wayleaves for 3725 miles out of the 4000 miles required for the main transmission scheme had been obtained. For primary lines operating at 132,000 volts only 84 miles remained to be negotiated. Out of 2876 miles, 2770 miles had already been constructed and the transmission scheme was practically complete in Central, North-East, Mid-East, and Eastern England and Central Scotland. About 1250 miles, including cables, were in operation, and satisfactory progress had been made in the standardisation of frequency. The total value of the contracts which had been placed with British firms and for which expenditure had been approved by the Board was £31,500,000. The production of electricity by authorised undertakers in Great Britain showed in 1931 an increase of more than 160 per cent. compared with 1921, and further expansion took place in the first five months of the present year. In these months the aggregate output was 5,267,000,000 units, which represents an increase of 8·3 per cent. compared with the corresponding period of last year.

Metals Research.

THE twelfth annual report of the British Non-ferrous Metals Research Association was issued during the past week. In spite of the intense industrial depression, the Association received by subscriptions from its members and by Government grant a total income of over £25,000. Consequently it has been possible to plan an extensive programme of work to carry out. During the past year the Association's new headquarters in London were brought into full use. The growth of the Association during the last eleven years is shown in the report by a diagram, indicating the income and its source, whether by subscription or otherwise for each year; in 1921 the total income was less than £6000. Great difficulties still have to be overcome, however, in financing the research work, and it is considered that taking into account the wide field of industry covered by the work of the Association the present membership of 200 is not as large as it should be. A section of the report deals with the future outlook and claims that even greater success would promptly accrue from fuller co-operation of existing members and from a moderate and steady increase in the funds available. The report also includes details of the various investigations that the Association now has in hand.

Colloidal Fuels for Marine Service.

WHEN the Cunard steamship "Scythia" left Liverpool for New York on Saturday last, June 11th, she carried 150 tons of a new colloidal fuel, which is to be burned under one of her six main boilers. When the ship called at Queenstown good progress was reported, and the complete results will be awaited with interest. The fuel is a mixture of 60 per cent. fuel oil with 40 per cent. of pulverised coal, and its conversion to a stable mixture has been developed by the collaboration of Mr. R. A. Adam, the Cunard Company's assistant superintendent engineer, Mr. F. C. Holmes, of the Cunard laboratory, and Mr. A. W. Perrins, the company's combustion engineer. Laboratory experiments were begun in September last and early in January a small-scale production plant was erected at the works of the Wallsend Slipway and Engineering Company at Wallsend-on-Tyne. Laboratory tests have shown, we understand, that the mixture remains stable under laboratory conditions, but the results of the present voyage should throw further light on its behaviour at sea. This colloidal fuel has been hailed in some quarters as an entirely new invention, but we would point out that a little over thirteen years ago, in our issue of May 9th, 1919, we dealt fully with the colloidal fuels, or coal and oil mixtures, devised by Mr. Lindon W. Bates, of New York, the Chairman of the American Submarine Defence Association, and their uses aboard ship and in land installations. To our knowledge other processes have also been recently developed for creating a stable mixture of coal and oil, and the revival of interest in this subject, which is of importance to our coal industry, will be carefully watched by both coal and oil companies and by possible users of such fuels.

Redundant Shipyards.

AT the third annual meeting of National Shipbuilders' Security, Ltd., which was held in Edinburgh at the end of last week, Sir James Lithgow, chairman of directors, said that during the past year substantial progress had been made in the industry's co-operative effort to deal with the problem of redundant capacity in an ordered and equitable way. During the past year, he went on to say, eleven shipyards had been purchased for scrapping or disposal under restrictive covenants against shipbuilding. Since March 31st, which marked the end of the financial year, two additional establishments had been purchased by the company. These were the shipyards of Bow, McLachlan and Co., Ltd., of Paisley, and Earle's Shipbuilding and Engineering Company, Ltd., of Hull. They represented the deletion of nine berths and an annual building capacity of 38,000 tons. In the two years of its activities, the company had dealt with a total of seventeen shipyards and ninety-one berths, capable of an annual output of 634,000 tons. Notwithstanding the depression in the industry, the income from levies received from members had more than met the debenture interest. The company was now in negotiation for the purchase of other shipyards, both in England and Scotland, and would continue to pursue its policy of curtailing the capacity of the industry, having due regard to the availability of labour and the facilities in the various localities in which the industry was carried on.

Brighton Line Electrification.

ACCORDING to an official Southern Railway statement, the first half of the London-Brighton electrification scheme will be opened on July 17th, when trains will run from London to Three Bridges. The second stage of the scheme, from Three Bridges to Brighton, will most likely be ready for service next March. New rolling stock sufficient for thirty-three trains has been designed for the service. The coaches are streamlined and are equipped with motors designed for possible speeds of 70 miles an hour. From July 17th there are to be sixty-one trains a day running from London to Three Bridges, compared with twenty-seven at present; in the opposite direction, fifty-seven trains instead of nineteen at present will be run. The fastest train has been timed to do the 30 miles in 39 minutes, while the average time for all the trains has been reduced from an hour to 52 minutes.

Scottish Industry.

ON Wednesday last, June 15th, there was issued a report of an Industrial Survey of the South-West of Scotland, which has been made for the Board of Trade by the staff of the Political Economy Department of the University of Glasgow. It is the first of four such industrial surveys which were decided upon last spring, and the report deals with the present industrial position, giving an estimate of the prospects of the various industries and their respective capacities to offer employment. The area covered comprises the counties of Lanark, including the city of Glasgow, Dumbarton, and Renfrew, and part of Ayr, in which there are 1,452,000 persons of working age and more than 700,000 insured workpeople in no fewer than twenty main groups of industries. In reviewing general tendencies reference is made to rationalisation, and the opinion is expressed that on the whole its effects and the tendencies which preceded it are adverse, but account must be taken of the ultimate effect of this movement. Commenting on the character of the workpeople, the statement is made that no more steady or dependable body of people is to be found in any similar industrial area. One of the most interesting sections of the report is that which deals with the shipbuilding and the engineering industries. The report visualises that in the post crisis year, which is thought to be 1934, insured employment will most likely be about 60 per cent. of that of 1929. After taking into account a net balance of about 50,000 in the entrants into insured occupations, the estimate of the report is that in 1934 the apparent surplus of male labour will be approximately 117,000 persons. Account is taken of the starting of new industries, but for a number of reasons the recovery in the South-West of Scotland will, it is expected, be relatively slow, but if the years beyond 1934 be looked to, it is held that there are grounds for a considerable degree of optimism.

Pressures and Stresses in Locomotive Parts.

By BRIAN REED.

WITHIN the last decade appreciable advance has been made in locomotive engineering by the use of high-grade material, and this, together with a greater knowledge of the stresses occasioned, has in many cases modified the values permitted in the large modern machines from those empirical figures which were for many years the standby of the usual class of designer.

The examples which make up the appended ten tables have all been drawn from locomotives constructed since 1919, the majority having been built during the last six years. These examples are given as representative of a large number of engines whose characteristics have been examined, with a view to assisting designers to keep abreast of modern practice.

CONNECTING AND COUPLING-RODS.

From Tables I. and II. it will be seen that high-tensile nickel-chrome steels are widely used, without the fullest advantage always being taken of their high yield point. For while, in general, a higher stress is countenanced than is permitted with Class C steel, the advance is nothing like in proportion to the increase in ultimate strength or yield point.

In considering the rods in the light of columns, with round and square ends for vertical and horizontal buckling, the Merriman formulæ have been used for obtaining the vertical and lateral stresses. In earlier days the latter were sometimes overlooked, and almost the first British high-tensile nickel-chrome steel rod failed through this omission before the engine had been in service for many hours. While it might be expected that the unit tensile stress would be kept low in a rod having a high value for the ratio Length/Rds of gyration, there is no indication of this having received attention in the horizontal direction, and very little in the vertical direction.

The vertical and inertia forces at speed have been calculated on the assumption that the steam pressure is equal to 0·33 of the normal working pressure, and that the speed, with one exception, is equal in miles per hour to the wheel diameter in inches. A consideration of the engine types and their wheel sizes, as given in Tables I. and II., will show these assumptions to be reasonable, while for the exception mentioned, a speed of 24 m.p.h. has been taken as the maximum attained by a shunting engine with 55in. wheels.

TABLE I.—*Connecting-rods.*

Railway	Southern.	L.M.S.	L.N.E.	Southern Pacific.	Hong Kong.	South Australia.	E.I.R.	G.W.R. of Brazil.	B.A.P.
Wheel arrangement	4–6–0	4–6–0	4–6–2	4–8–2	4–6–0	2–8–2	0–6–0	2–6–2 2–6–2	4–6–2
Material	Nickel-chrome, 60–70 tons ultimate. 50 t. yield.	Nickel-chrome, 50–60 tons ultimate. 42 t. yield.	Nickel-chrome, 50–60 tons ultimate. 40 t. yield.	Carbon-vanadium, 40 tons ultimate.	Nickel-chrome, 50–60 tons ultimate. 42 t. yield.	Nickel-chrome, 50–60 tons ultimate. 42 t. yield.	Class C carbon steel.	Nickel-chrome, 50–60 tons ultimate. 42 t. yield.	Nickel-chrome, 60–70 tons ultimate. 50 t. yield.
Cyls., dia. and stroke, in.	16½ × 26	18 × 26	20 × 26	28 × 30	?	22 × 28	20 × 26	14½ × 22	18½ × 26
Dia. of coupled wheels, in.	79	81	80	73·5	72	57	61·5	42	71
Boiler pressure, lb./in.²	220	250	180	210	?	200	160	200	175
Piston load, P, lb.	47,000	63,700	56,500	129,000	62,300	76,000	50,260	31,850	48,320
Position of rod	Outs.	Ins.	Ins.	Outs.	Outs.	Outs.	Ins.	Outs.	Outs.
Length of rod, cr. to cr., L, in.	132	81	97	112	136·5	119	77	90	127
Weight of rod, C.S.A. × L × 0·283, lb.	204	129	150	475	228	216	118	98	182
Section of rod	I	I	I	I	I	I	I	I	I
Tensile stress at small end, lb./in.²	9,400	12,150	13,100	9,225	11,580	12,000	10,180	8,730	10,950
C.S.A. at centre of rod A, in.²	5·46	5·616	4·7	15·0	5·937	6·4	5·437	3·84	4·69
Tensile stress at cr. of rod, lb./in.²	8,630	11,320	12,050	8,620	10,480	11,900	9,250	8,310	10,320
Vertical stress (as strut), lb./in.²	10,600	12,000	13,670	9,500	12,800	13,800	9,900	9,150	12,850
Horiz. stress (as strut), lb./in.²	11,700	13,150	18,250	10,200	16,500	13,700	10,400	10,100	14,350
Speed for inertia calcs., m.p.h.	79	81	80	73·5	72	57	61·5	42	71
Per cent. of B.P. at speed	33·3	33·3	33·3	33·3	33·3	33·3	33·3	33·3	33·3
P/A at speed, lb./in.²	2,876	3,772	4,016	2,870	3,490	3,966	3,083	2,760	3,440
Inertia force at speed, lb./in.²	10,100	3,090	6,050	9,400	11,100	7,200	3,525	4,020	9,630
Vertical force at speed, lb./in.²	3,100	3,880	4,200	3,250	3,700	4,200	3,160	2,850	3,820
Comb. vert. and inertia force, lb./in.²	13,200	6,970	10,250	12,650	14,800	11,400	6,685	6,870	13,450

The spring load is responsible for only a small portion of the total stress in the axle, and in these days of big piston loads and low factors of adhesion bears a smaller proportion to the whole than was the case fifteen or twenty years ago. The bending moment arising from the spring load must be combined with the bending moment due to the piston thrust, and their resultant then combined with the twisting moment to obtain the equivalent bending moment.

For the purpose of these comparisons the bending moments of maximum force due to piston load and inertia do not coincide.

STRAIGHT DRIVING AXLES AND CRANK PINS.

Normal axle steel of 35–40 tons per square inch ultimate strength, combined with an elongation of 25–20 per cent., is still the favourite material, but many foreign lines have introduced nickel and nickel-chrome alloys, rarely, however, in combination with an ultimate strength in excess of 40 tons. There is a distinct trend towards the use of high-tensile nickel-chrome steel crank pins, the material ranging from 40 to 60 tons per square inch in ultimate strength, with an elongation of 21·5 per cent. down to 10 per cent. in 2in. Hollow boring has been carried out in a number of large engines, and this practice might, with advantage, be extended.

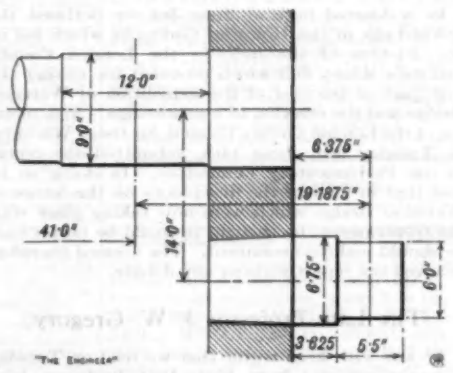
TABLE II.—*Coupling-rods.*

Railway	L.M.S.	L.N.E.	G.W.R.	B.A.P.	Southern Pacific.	South Australia.	E.I.R.	B.A.G. S.R.	Colombian.
Wheel arrangement	4–6–0	2–6–0	4–6–0	4–6–2	4–8–2	2–8–2	0–6–0	2–6–2	2–6–2 2–6–2
Material	Nickel-chrome, 50–60 tons ultimate. 42 t. y.p.	Nickel-chrome, 50–60 tons ultimate. 40 t. y.p.	45 tons ultimate.	Nickel-chrome, 60–70 tons ultimate. 50 t. y.p.	Carbon-vanadium, 40 tons ultimate.	Nickel-chrome, 50–60 tons ultimate. 42 t. y.p.	Class C carbon steel.	Nickel-chrome, 50–60 tons ultimate. 42 t. y.p.	Class C carbon steel.
Piston load, P, lb.	63,700	48,400	60,500	48,320	129,000	76,200	50,260	59,000	32,000
Wheel dia., in.	81	68	80·5	71	73·5	57	61·5	55	40
Crank radius, in.	13	13	15	13	15	14	13	13	11
Position of rod	Leading	Trailing	Trailing	Leading	Inter.	Inter.	Trailing	Leading	Leading
Length of rod, cr. to cr., L, in.	88	105	93	81	78	62	93	78	47
Weight of rod, C.S.A. × L × 0·283, lb.	117	161	216	89	240	60	123	100	33
Section	I	I	Rect. taper	I	I	I	I	I	I
Max. load on rod, lb.	39,200	33,500	31,600	33,100	81,000	48,600	27,600	49,280	11,650
C.S.A. at centre, in.²	4·71	5·41	8·25	3·85	10·87	3·44	4·68	4·55	2·5
Unit stress at centre, lb./in.²	8,340	6,200	3,840	8,600	7,450	14,240	5,920	10,800	4,660
Vertical stress (as strut), lb./in.²	8,670	6,650	4,040	9,500	7,570	15,200	6,300	12,350	4,900
Horiz. stress (as strut), lb./in.²	9,600	7,300	4,500	10,600	7,880	15,900	6,700	12,900	5,000
Speed for inertia calcs., m.p.h.	81	68	80·5	71	73·5	57	61·5	24	40
Per cent. boiler press. at speed	33·3	33·3	33·3	33·3	33·3	33·3	33·3	33·3	33·3
P/A at speed, lb./in.²	2,230	1,480	810	2,070	1,970	3,680	1,180	1,430	1,410
Inertia stress at speed, lb./in.²	5,300	11,950	14,550	9,660	4,580	4,980	9,180	1,120	3,400
Vertical stress at speed, lb./in.²	2,240	1,510	830	2,110	1,975	3,720	1,200	1,440	1,430
Comb. vert. and inertia stress, lb/in.²	7,540	13,460	15,380	11,770	6,555	8,700	10,380	2,560	4,830

Reduction in the stresses arising from centrifugal force in coupling-rods has been effected in a marked degree. The average inertia stress of the alloy steel rods in Table II. is 8500 lb. per square inch, while an analysis of twelve pre-war British rods of Class C steel gave a corresponding value of 14,100 lb. with a lowest figure of 9600 lb. This, of course, is due to the lighter section which an alloy steel permits, but it must be admitted that more attention is given to design nowadays.

The maximum load which may be thrown upon one coupling-rod, apart from inertia, has been taken as equal to the force required to slip the driven wheels, assuming a factor of adhesion of 3·5. The total piston load can be transmitted down one side only, and this occurs twice in each revolution, but the ing moment on the crank pin, due to the piston thrust, is taken as acting at the face of the wheel boss, instead of a short distance inside it, which is the actual position of the maximum. As an example of the method employed, the axle and crank pin of the Southern Railway "King Arthur" class—Table III. may be taken, the proportions being given in Fig. 1.

The examples included in Table III. yield a mean equivalent bending stress of 10·3 tons per square inch, and the bearing pressure due to spring load—a vital factor influencing the proportions of the journal—at 179 lb. per square inch of projected area. As regards the crank pins, there is a great deal of diversity in both bending stresses and bearing pressures. The high-tensile alloy steels—as, for example, those used on the South Australian "Pacifics"—do not consistently show a higher stress than the normal 32–36-ton oil-hardening steel, but there is some



Piston load, 66,000 lb.
B.M. on pin = 66,000 × 6·375 = 421,500 in.-lb.
Diameter of pin = 6·75in. Sec. mod. = 30·19.
Stress = 13,960 lb. per square inch.
Bearing pressure on big end = 66,000/33 = 2000 lb. per square inch.
Centres of rails taken as 60in. apart.
B.M. due to piston load = 66,000 × 19·1875 = 1,266,000 in.-lb. = 565 in.-tons.
B.M. due to spring load = 17,200 lb. × (60 − 41)/2 = 17,200 × 9·5 = 163,000 in.-lb. = 73 in.-tons.
Comb. B.M. = $\sqrt{565^2 + 73^2}$ = 569·9 in.-tons.
Max. T.M. = 66,000 × 14 = 924,000 in.-lb. = 412 in.-tons. 412 in.-tons—force necessary to turn one wheel = 412 − (10·0 × 0·25 × 39·5) = 313·5 in.-tons.
Equiv. B.M. $\sqrt{569 \cdot 9^2 + 313 \cdot 5^2}$ = 650·2 in.-tons.
Dia. = 9·0in. Sect. mod. = 71·57. Stress = 9·1 tons per sq. in.
Bearing pressure on journal due to spring load (180 deg. arc) = 17,200/108 = 159 lb. per sq. in.
Bearing pressure due to piston load = 1030 lb. per sq. in.
Shearing stress on pin between connecting and coupling-rods = 66,000/area 6in. dia. = 2330 lb. per sq. in.

STRESSES ON CRANK PIN AND JOURNAL

TABLE III.—*Straight Driving Axles.*

Railway	G.W.R.	South Australia.	Southern.	L.M.S.	L.M.S.	Indian State.	L.N.E.	Polish State.
Wheel arrangement	4–6–0	4–6–2	4–6–0	2–6–4T	4–6–4T	2–8–2	0–8–0	2–10–0
Spring load, lb.	15,600	21,250	17,200	15,800	15,700	20,400	15,500	14,500
Piston load, lb.	60,500	90,500	66,000	56,600	68,400	91,000	56,500	102,800
B.M. on crank pin in.-tons	212	364	188	190	214	355	194	424
B. stress on crank pin, tons/in.²	7·87	7·25	6·24	7·05	5·7	5·9	9·15	8·8
Bearing press., crank pin, lb./in.²	1,680	1,588	2,000	1,800	1,840	1,785	1,778	2,120
Shearing stress on pin, lb./in.²	2,140	2,195	2,330	2,000	1,910	1,810	2,880	2,470
B.M. on journal due to piston load, in.-tons	514	929	565	466	573	894	454	1,023
B.M. on journal due to spring load, in.-tons	55·7	109	73	60	63	83	60	54
Max. T.M. through journal, in.-tons	312·5	453	313·5	251	316	522	251	584
Equivalent B.M., in.-tons	604	1,039	650	533	657	1,038	533	1,179
Equivalent B. stress, tons/in.²	9·2	8·53	9·1	10·6	10·9	10·57	10·6	12·9
Bearing press., spring load, lb./in.²	178	152	159	220	176	170	220	141
Bearing press., piston load, lb./in.²	1,130	1,090	1,030	1,450	1,240	1,250	1,450	1,675

evidence that difficulty is being experienced in obtaining sufficient bearing area for piston loads in excess of 100,000 lb., for the Polish State "Decapod" is at the head of the table with 2120 lb. per square inch, while the large Austrian two-cylinder 2–8–4 engine, with a piston thrust of 118,000 lb., has a value of 1920 lb. per square inch. An analysis of thirty engines built within the last ten years showed an average bearing pressure of 1730 lb. per square inch of projected area—upper and lower limits, 2120 lb. and 1415 lb. respectively—and for the bending stress, 16,650 lb. per square inch average—upper and lower limits, 22,100 lb. and 7850 lb. per square inch respectively.

It is important that plenty of bearing area should be provided in the axle-box to take up the piston thrust, and for that purpose the brass is extended slightly below the centre line, a complete bottom brass being occasionally fitted. Allowing for the piston load to be taken up on the projected area of the top 90 deg. arc, plus whatever area the design allows below the centre line, the average value for the bearing pressure of the eight examples composing Table III. is 1338 lb. per square inch.

TABLE IV.—*Single-throw Crank Axles.*

Railway	L.N.E.	B.A.P.	Danish.	B.A.G.S.R.	C.U.R.	Czecho-Slovak.
Wheel arrangement	4–6–2	4–6–2	4–6–0	2–6–4T	2–8–0	4–6–2
Spring load, lb.	15,700	15,500	14,600	15,700	12,300	14,500
Piston load (one cylinder), lb.	56,500	48,320	45,800	48,100	43,300	62,100
B.M. on outside pin, in.-tons	183	164	145	177	152	205
B. stress on outside pin, tons/in.²	8·62	8·78	3·5	5·86	8·15	7·6
Shearing stress on pin, lb./in.²	2,375	2,500	1,375	1,700	2,440	2,600
Bearing pressure on pin, lb./in.²	1,710	1,610	1,495	1,457	1,820	1,878
B.M. on journal: outside piston load, in.-tons	502	404	395	425	367	524
B.M. on journal: spring load, in.-tons	68·5	55·5	54·5	59·6	42·6	54
Max. T.M. from outside cylinder, in.-tons	228	194	192	201	195	290
T.M. from inside cylinder, in.-tons	81	70	67·5	70	63	93
Equivalent B.M., in.-tons	561	458	448	479	422	608
Equivalent B. stress, tons/in.²	6·54	6·4	8·125	6·7	7·0	9·5
B.M. on inside crank pin, in.-tons	255	285	221	279	215	299
B. stress on inside crank pin, tons/in.²	4·62	4·75	3·05	3·9	3·57	3·6
Bearing press. on inside pin, lb./in.²	1,140	1,136	757	972	925	1,043
Bearing press. on journal-spring, lb./in.²	150	172	173	175	161	164
Bearing press. on journal-piston, lb./in.²	915	960	920	960	965	1,100

SINGLE-THROW CRANK AXLES.

Attention has been confined to those three-cylinder engines whose drive is taken up on one axle only. The driving axles, the material not having such a great strength, while in built-up units the desirability of a large diameter fit in the web pushes the journal diameter up above the figure required for strength alone. The pin diameter being much the same as that of the journal, the stress and pressure values are lower than in two-cylinder engines, where the piston thrust is usually much greater. The average crank pin bearing pressure of twelve three-cylinder engines proved to be only 910 lb. per square inch of projected area, against the 1320 lb. average of twenty two-cylinder engines.

DOUBLE-THROW CRANK AXLES.

Similar methods of calculation to the above have been applied to the six double-throw crank axles which make up Table V. The maximum equivalent bending stresses at the journal are all fairly high, a contributory cause being the large proportion of the total twisting moment which it is possible to transmit through one journal. Reverse bending moment over the journal, and bending moment due to coupling rod thrust, have been considered, for, in contra-distinction to an outside cylinder design, their effect is appreciable. It will be noted that the stresses in the leading driving axles of the Southern Railway "Lord Nelson," and the Norte 4–8–2 engines, both four-cylinder machines with divided drive, material of the solid single-throw axles approximates to the British Standard Specification for Crank Axles, but in some cases is equal only to a minimum strength of 28 tons per square inch. The method employed for working out the equivalent bending stress is but an extension of that used for straight driving axles, account being taken of the inside cylinder. In this connection it should be noted that the twisting moment from the inside cylinder which passes through one journal when one of the outside cylinders is transmitting its maximum twisting moment is only one-quarter of the normal, the cranks being taken as at 120 deg. spacing.

From Table IV. it will be seen that the resultant stress is appreciably below that found in straight

TABLE V.—*Double-throw Crank-axles.*

Railway	E.I.R.	G.S.R. (I).	L.N.E.	G.W.R. (T.V.R.)	Southern.	Norte.
Wheel arrangement	0–6–0	0–6–0	2–6–4 T	0–6–2 T	4–6–0	4–8–2
Spring load, lb.	15,700	12,900	17,500	16,200	17,000	12,500
Piston load, lb.	50,260	49,600	62,400	43,000	47,000	57,500
B.M. on inside crank pin, in.-tons	259	238	331	206	242	340
B. stress. in inside crank pin, tons/in.²	4·3	5·75	4·25	3·43	3·4	3·8
Bearing press., ,, ,, ,, lb./in.²	1315	1470	1350	1265	1160	1035
B.M. on journal eplg. rod thrust, in.-tons	342	342	509	295	143	290
,, ,, ,, spring load, in.-tons	49	39	48	50·5	53	38
T.M. through journal, in.-tons	360	354	447	309	338	425
Equivalent B.M., in.-tons	499	493	679	431	371	516
,, B. stress, tons/in.²	9·95	11·9	9·5	8·6	5·2	7·12
Bear. press. on journal, spring load, lb./in.²	218	216	216	225	180	135
,, ,, ,, ,, piston ,, ,,	1,240	1,458	1,250	936	750	1030

TABLE VI.—*Coupled Axle-boxes.*

Railway.	Gauge.	Type.	Cylinder position.	Sprung load, lb.	Dia. × length of brass, in.	Pressure on journal, lb./in.²	Frames.
L.N.E.R.	4ft. 8½in.	4–6–2	Ins. & outs.	17,500	9·5×11·0	167	Plate
L.M.S.R.	,,	4–6–0	,,	18,100	9·0×10·5	192	,,
Southern	,,	4–6–0	,,	18,300	9·0×10·5	193	,,
G.W.R.	,,	4–6–0	Outs.	16,000	8·75×10·0	183	,,
Austrian F.	,,	2–8–4	,,	15,000	9·43×12·6	126	,,
Belgian N.	,,	2–8–2	,,	20,200	10·25×12·75	155	Bar
Indian State	5ft. 6in.	4–6–2	,,	14,900	8·25×11·25	162	Plate
S. Australian	5ft. 3in.	4–6–2	,,	23,000	10·75×13·0	164	Bar
B.A.P.R.	5ft. 6in.	4–6–2	Ins. & outs.	17,800	9·0×10·0	198	Plate
Southern	4ft. 8½in.	2–6–0	,,	16,850	8·5×9·0	220	,,
L.M.S.R.	,,	2–6–4T	Outs.	15,300	8·0×9·0	213	,,
Danish St.	,,	2–6–4T	Ins. & outs.	13,750	8·25×10·25	163	,,
L.M.S.R.	,,	0–6–0	Ins.	15,500	8·0×8·25	235	,,
L.N.E.R.	,,	0–6–0	,,	17,300	8·0×9·0	240	,,
L.N.E.R.	,,	2–8–2	Ins. & outs.	17,500	8·5×9·0	228	,,
Polish St.	,,	2–10–0	Outs.	15,100	9·06×10·6	158	Bar
Indian State	5ft. 6in.	2–8–2	,,	20,900	10·0×12·0	174	Plate
E.I.R.	,,	0–6–0	Ins.	16,700	8·0×9·0	232	,,
Bulgarian	4ft. 8½in.	2–12–4T	Outs.	15,500	9·06×9·06	189	Bar
L.N.E.R.	,,	0–6–0T	Ins.	13,300	6·5×7·5	272	Plate

are considerably lower than in the normal two-cylinder type.

COUPLED AXLE-BOXES.

The pressure per square inch of projected area is somewhat higher than the corresponding figure for driving axle-boxes on the same engine, for not only are the stresses less, but for equal axle loads the sprung weight is higher, owing to the omission of the connecting-rod portions, excentrics, and crank webs, and to the smaller balance weights employed. The twenty examples comprising Table VI. have been taken as representative of over fifty boxes examined, which covered all classes of passenger, goods, and shunting engines, on the standard and wider gauges. From the total number the following average bearing pressure values were extracted:—

	Lb. per sq. in.
Express passenger engines	177
Mixed traffic, including fast passenger tanks	195
Goods and shunting engines	208

These figures are all much below the value of 2 cwt. per square inch, which was for many years taken as the normal pressure. The reduction has been brought about in many cases by the longer non-stop runs now made, more especially by locomotives having axle loads in excess of 20 tons, with the consequent necessity of absolute reliability. To the British engineer it is noteworthy that the four examples which are fitted in bar frames have pressures appreciably below the average for that particular class of locomotive.

CARRYING AXLE-BOXES.

Carrying axle-box pressures—Table VII.—have not changed greatly from pre-war days. An analysis of thirty leading bogie or leading pony truck boxes in express passenger and mixed traffic service yielded an average of 150 lb. per square inch of projected area, which was the old standard figure, while similar boxes in goods service gave a mean of but 5 lb. higher. Fifteen trailing truck and trailing radial boxes gave an average of 194 lb. per square inch, while a similar examination of the same number of tender boxes yielded a mean of 230 lb., which is very close to the old rule of 2 cwt. Table VII. gives a selection from all the above boxes. The actual pressure is, of course, much higher, for in carrying axles the brass extends only over an arc of some 60 deg. to 90 deg.

The pressures now used in British and Continental practice—including foreign orders—approximate fairly closely to the values recommended by the American Railroad Association for grease-lubricated boxes, the latter being:—

	Lb. per sq. in.
Coupled—	
Passenger	175
Freight	200
Switching	200
Engine truck, leading—	
Passenger	160
Freight	180
Engine truck, trailing—	
Passenger	200
Freight	210

An examination of Tables VI. and VII. yields some interesting results. The L.N.E.R. favour low pressures for coupled and leading bogie boxes, but for tender and trailing radial types their figures are very high. Tender bogie boxes seem to have lower pressures than are found in six and eight-wheel rigid-frame types, but express passenger vehicles have not always a low value. In general, Continental values for coupled boxes are below those prevailing in British practice, the axle loads being less, while the corresponding figures for carrying axles are higher, the loads in this case being greater.

TABLE VII.—*Carrying Axle-boxes.*

Railway.	Gauge.	Type.	Wheel.	Box.	Sprung load, lb.	Dia. × length of journal, inches.	Pressure on journal lb./in.²
L.N.E.R.	4ft. 8½in.	4–6–2	Bogie	In.	8,200	6·5 × 9·0	140
L.M.S.R.	,,	4–6–0	,,	,,	11,600	6·25×11·0	168
Southern	,,	4–6–0	,,	,,	10,250	6·5 ×11·0	144
G.W.R.	,,	4–6–0	,,	,,	8,100	6·5 ×11·0	114
Nanking S.R.	,,	4–6–2	,,	,,	10,000	6·25×11·0	145
Austrian F.	,,	2–8–4	L. truck	,,	14,700	7·87×11·68	150
Belgian	,,	2–8–2	,,	,,	17,000	7·5 ×14·2	160
B.A.P.R.	5ft. 6in.	4–6–2	Bogie	,,	11,800	7·0 ×9·0	187
L.M.S.R.	4ft. 8½in.	2–6–4T	L. truck	,,	11,400	6·25×11·0	166
C. Argentine	5ft. 6in.	2–8–2	,, *	,,	8,950	6·0 ×10·5	142
Indian State	,,	2–8–2	,,	,,	11,000	6·75×10·5	155
L.N.E.R.	4ft. 8½in.	2–8–2	,,	,,	9,750	6·5 × 9·0	167
L.N.E.R.	,,	2–8–2	Tr. radial	Outs.	16,200	6·0 ×11·0	245
Nanking S.R.	,,	4–6–2	,,	,,	16,600	7·5 ×12·0	185
Indian State	5ft. 6in.	2–8–2	,,	,,	18,700	7·0 ×12·5	214
S. Australian	5ft. 3in.	4–6–2	Tr. truck	,,	21,200	9·0 ×14·25	166
Belgian N.	4ft. 8½in.	2–8–2	,,	,,	21,400	7·87×13·75	198
L.N.E.R.	,,	4–6–2	Tender	,,	14,300	5·5 ×10·0	260
L.M.S.R.	,,	4–6–0	,,	,,	14,000	5·5 ×10·5	242
Southern	,,	4–6–0	Ten. bogie	,,	14,000	6·5 ×13·0	166
Nanking S.R.	,,	4–6–2	,,	,,	17,800	6·0 ×13·0	228
Indian State	5ft. 6in.	4–6–2	,,	,,	16,150	6·0 ×13·0	207

SLIDE BARS.

The lay-out of some of the recent six and eight-coupled engines has necessitated an exceptionally great distance between the working face of the slide bars and the front supports. I-section bars have in

TABLE VIII.—*Slide Bars.*

Railway.	No. of bars	Cyls.	Thrust on bar, tons.	Length between supports inches.	Bending moment in.-tons.	Width of bar, in.	Depth of bar, in.	Bending stress, tons/in.²	Deflection of bar, inch.
L.M.S.R.	1	Outs.	3·01	58·0	42·8	6·0	4·0	2·68	0·028
Austrian F.	1	,,	4·07	65·75	66·7	5·75*	6·3	2·04	0·0166
B.A.G.S.R.	1	Ins.	3·14	56·0	43·7	6·0	3·5	3·57	0·0398
Southern	2	Outs.	3·12	48·0	24·75	5·5	3·0	3·0	0·026
B.A.P.	2	,,	2·205	39·5	12·7	4·5	2·25	3·35	0·0253
Nanking S.R.	2	,,	3·45	46·25	24·5	5·5	2·75	3·53	0·0295
Pekin–Mukden	2	,,	3·45	55·75	45·6	5·0	3·75	3·89	0·0383
L.N.E.R.	3	Ins.	3·38	52·5	43·0	7·5†	2·25	6·8	0·098
L.M.S.R.	4	,,	4·57	57·0	64·0	3·0	3·0	7·1	0·097
E.I.R.	4	,,	3·78	39·0	32·8	3·25	2·375	5·35	0·0402

* I. section bar. † Top bar, forward direction.

some cases been employed in order to gain maximum rigidity with minimum weight, but it is questionable whether the extra machining cost makes this worth while, for the metal thus removed is so slight as to be negligible, even when weight saving is of prime importance.

Stiffness of the bar is the criterion of good design, rather than the bending stress, and a consideration of Table VIII. will show that modern designs are, on the whole, quite good in this respect. While a couple of examples are included in Table VIII. in which the deflection is over $\frac{1}{16}$in., this amount may not prove—depending upon the design of the crossheads—to be as serious as it seems at first sight, but it is to be noted that they occur in three and four-bar lay-outs. In all cases the deflection has been calculated at the point of maximum connecting-rod thrust, for in many designs there is virtually no upward thrust midway between the supports, and in no case does the point of maximum thrust coincide with the mid-point.

The best position for the outer support is somewhere near mid-stroke, but this cannot always be arranged. The low deflection figures of the N.S.R., Southern, and B.A.P. examples, show the extent of the benefit to be derived from close supports, for the distances from the back supports to the points of mid-stroke are respectively 8·75in., 10·0in., and 7·0in. The stress is somewhat incidental, being governed largely by the requirements of stiffness and bearing area for the slipper. Average values for single and double bars do not vary greatly, but the range between upper and lower limits of the latter appears to be less than that of the former. An average of 3·8 to 4·0 tons per square inch for single and double bars gives place to an average of 6·5 tons when four bars are used. As Class D steel of 35–40 tons per square inch ultimate strength is almost universal for slide bars, even this latter value gives a factor of safety of over five, but the stiffness of the general run of four-bar arrangements is not so good as with the single and double patterns.

TABLE IX.—*Crossheads and Pins.*

Railway	L.M.S.	C.S.R.	N.S.R.	L.N.E.	P.M.R.	L.N.E.	S.R.	L.M.S.	E.I.R.	Penn. R.
Wheel arrangement	4–6–4T	4–6–2	4–6–2	0–8–0	2–8–2	4–6–2	4–6–0	4–6–0	0–6–0	2–10–0
No. of Bars	1	1	2	2	2	3	3	4	4	1 triple
Piston load, tons	30·6	28·25	29·5	25·25	27·8	25·25	21·0	28·4	22·4	81·5
Conn. rod thrust, tons	3·01	3·37	3·45	2·74	3·45	3·4	2·06	4·57	3·78	9·85
Slipper area, sq. in.	96	85	104·5	85	106·5	105	105	120	97·5	726
						58	63			376
Pressure, lb./in.²	70	89	74	72	72·5	72	44	86	86·5	30·5
						130	75			58·5
Gudgeon pin. di.×lgth, in.	4×4·25	3·5×3·5	3·75×3·75	3·25×3·0	3·75×3·75	3×4	3·25×3·25	3·5×3·5	3·25×3	6·5×6·5
Bearing pressure, lb/in.²	4,040	5,015	4,700	5,800	4,350	4,700	4,440	5,200	5,160	4,325
Shearing stress, lb./in.²	2,700	3,180	3,000	3,400	2,830	4,000	2,835	3,310	3,030	2,760
Bending moment, in.-tons	16·25	12·5	13·8	9·5	13·0	12·5	8·54	12·4	8·4	66·2
Bending stress, lb./in.²	5,830	6,440	5,960	6,310	5,640	10,600	5,660	6,500	5,600	5,355

Crossheads and Gudgeon Pins.

The necessity of keeping down the slipper pressure has occasioned the use of triple bars in some of the latest locomotives, the arrangement being most popular with passenger engines, which do most of their work in forward gear. For while the pressure against the top bar is low, *e.g.*, 44 lb. per square inch in the "Lord Nelson," the pressure on the bottom bars is high, owing to their width being cut away to clear the crosshead and connecting-rod. The new Indian standard locomotives, and the latest South African 4–8–2 engines, however, use two wide, flat bars, the crosshead encircling the bottom bar. Triple bearing faces, arranged one above the other, have been found necessary on the Pennsylvania "Decapods," to take up the thrust, in the forward direction, of 9·85 tons, resulting from a piston load of over 80 tons. Two working faces are provided for backward running, but in each case the pressure is very low—see Table IX.

Lack of room above the axle makes the four-bar arrangement subject to high stresses and pressures, for the bars are relatively shallow, and the small value of the connecting-rod : crank ratio produces a comparatively large thrust on the bars. However, there is not such a wide variation in the pressure between top and bottom limits as there is with single and double bar lay-outs.

Average values from a large number of recent engines, of which Table IX. is representative, are :—

	Average. Lb.	Upper. Lb.	Lower. Lb.
One bar	69	89	58
Two bars	66	85	40
Three bars—Foreward	62	78	55
Backward	101	128	68
Four bars	85	93	79

It would appear to be quite safe to allow a bearing pressure on the gudgeon pin of 5000 lb. per square inch. An average of twenty-five recent designs came out at 4800 lb. per square inch of projected area, the highest pressure being 6400 lb. per square inch and the lowest 4050 lb. For these same pins the bending stress varied between 10,600 lb. per square inch and 5250 lb., with a mean of 6620 lb. While the highest values were, in general, found in conjunction with high piston loads, the top value is that of the L.N.E.R. "Pacific," with a piston thrust of only 56,500 lb., the pin being 3in. diameter by 4in. long. The bending stress was obtained by treating the pin as a beam supported at the ends and uniformly loaded over the span, the bending moment being given by W L/8. It is occasionally the practice to figure the gudgeon pin stress as that due to a concentrated load, in which case the bending stress is twice the value of that given above, but such a case could represent only an extreme state of bad fitting.

Piston-rods.

There is little indication that piston-rods have received more consideration as columns than have connecting-rods. While in some cases it is found that rods with a high value for the ratio length/rds of gyration have a low tensile stress, this can by no means be taken as axiomatic. Indeed, some of the short rods of inside-cylinder locomotives have stresses much below the usual run. It would appear that some improvement might be made in this direction, for the stress when the rod is viewed as a long column goes up rapidly with increasing values of the above ratio. A case in point is to be found in the "Lord Nelson." Inside and outside rods are each 3½in. diameter, but the latter are some 66in. long, against the 45in. of the former. In consequence the vertical stress in the outside rod is—Merriman formulæ—7250 lb. per square inch, compared with 6600 lb. for the inside rod, the unit stress through the body being 6135 lb. per square inch.

Twenty Class D steel rods gave, on examination, an average tensile stress at the centre of 5800 lb. per square inch, with 9200 lb. at the smallest cross-sectional area, the latter being usually at the bottom of the thread, but occasionally at the cotter hole when a large tail rod is used. Nickel-chrome and vanadium steel rods are now employed to some extent, but the increase in stress of the examples in use is not great, for while the average of twelve alloy steel rods, with an ultimate strength of over 40 tons, came out at 7325 lb. unit stress, the stress at the smallest cross section was only 9850 lb. per square inch.

TABLE X.—*Piston-rods.*

Railway	B.A.P.	L.M.S.	N.S.R.	P.M.R.	S.R.	S.P.R.R.	L.N.E.	C.S.R.	E.I.R.	Polish.
Wheel arrangement	4–6–2	4–6–4T	4–6–2	2–8–2	4–6–0	4–8–2	4–6–2	4–6–2	0–6–0	2–10–0
Piston load, tons	21·6	30·6	29·5	27·8	29·5	57·6	25·25	28·25	22·4	46·0
Length of rod, inches	48	48	53	49·5	59·5	62	45	64	41	53·5
Diameter of body, inches	3·25	3·5	3·875	3·5	3·75	4·75	3·5	3·75	3·25	3·937
						2·0 bore	2·125 bore			
Unit stress at cr., lb./in.²	5,820	7,140	5,600	6,480	6,000	8,850	9,300	5,740	6,060	8,350
Stress as column, lb./in.²	6,650	8,340	6,420	7,550	7,320	8,860	9,800	7,060	6,700	10,300
Tens. stress, max., lb./in.²	11,200	11,000	10,200	10,000	10,650	9,100	10,800	9,040	9,300	12,300
Shear stress on cotter, lb./in.²	10,800	11,000	11,000	9,400	Nil	?	8,850	12,500	11,100	12,750
Material	Nickel-chrome 50–60 t. ult.			36–38 t. "D" steel		Carbon-vanadium 40 t. ult.	Nickel-chrome 50–60 t. ult.		"D" steel	

In an investigation of the effect of moisture in salt baths for steel treating it was found, according to *Heat Treating and Forging*, that the addition of only 1 pint of water to a bath containing several hundredweights of salt would either increase penetration on a thick section of plate which otherwise may not have been quite perfect or on a thinner plate produce brittleness. These effects increased in accordance with the addition of definite amounts of water until a stage was reached where the results obtained were little better than those from an ordinary water quench.

The Modern Slide Rule.

By H. O. COOPER.

MANY improvements have been made to the slide rule of recent years, and new rules have been designed to facilitate calculation in various more specialised kinds of work. It is not the purpose of this article to describe these different types, but it is felt that the convenience afforded by the newer engineers' slide rules is not always being taken advantage of by their users, who, in many cases, still employ methods which were the sole means of calculating with the older type. Particularly are these improvements apparent in finding roots and powers of numbers in formulæ, as formerly the only means available were the log-log scale and the evenly divided scale. Both these require the root or power to be read off and again set on the ordinary scales if it occurs in a formula; this leads to inaccuracies and often to serious errors. Although many roots and powers still require a log-log scale for solution, others can be worked so as to make the result available for further operations, by bringing it on to the ordinary scales.

The slide rule here considered is fitted with the usual A, B, C and D scales, a log-log scale, and it may have scales for voltage-drop and the efficiencies of dynamos and motors, these latter being added to some types for electrical engineers. In addition to the above, the newer slide rules carry a reciprocal scale and a scale of cubes. To avoid resetting the slide when a reading just falls beyond the end of the scales, some of these rules are lengthened a little, and the scales commence a short distance to the left of 1 and are extended beyond 100 on A and B, and beyond 10 on the C and D scales, these extra division lines often being marked in red. The illustration shows a modern engineers' slide rule.

The reciprocal scale, which is usually placed along the centre of the slide, is identical with the C scale—the lower slide scale—except that it is graduated from right to left. This arrangement permits a number of direct calculations only otherwise possible with the reversed slide, and not always then. As its name implies, this scale, Cr, as it will be referred to here, gives the reciprocals of all the numbers on scale C. For instance, over 2 on C read 0·5 on Cr, over 0·4 read 2·5, &c. If otherwise difficult to estimate, it is easy to remember that the number of ciphers immediately after the decimal point in the reciprocal of a whole-number is one less than the number of figures in the number, while the number of figures in the reciprocal of a decimal is one more than the number of ciphers following the decimal point in the number. For instance, in 1/386 there will be two ciphers after the decimal point; thus, 1/386 =0·00259. Alternatively, the number may be changed by shifting the decimal point so as to leave only one figure to the left of it, when the first figure of the reciprocal will immediately follow the decimal point. For instance,

$$1/386=\frac{1}{3\cdot86}\times10^{-2}=0\cdot259\times10^{-2}=0\cdot00259,$$

and $$\frac{1}{0\cdot0045}=\frac{1}{4\cdot5}\times10^{2}=0\cdot2222\times10^{2}=222\cdot2.$$

In combination with the D scale, Cr can be employed for multiplication and division, but the procedure is reversed. In multiplying, the two factors are brought together and the product is read on D under 1 or 10 on Cr. For division, 1 or 10 on Cr is set to the dividend on D, and the quotient is read on D in line with the divisor on Cr.

With numbers of convenient size, it is possible to find the product of three factors, or the quotient when there are two divisors, with one setting of the slide. When one factor on Cr is set to a second factor on D, the product will be found on D in line with 1 or 10 on Cr; it is also found on Cr in line with 1 or 10 on D. But the slide is now in position for multiplying this product by the third factor on scale C, the product of the three factors being on D in line with the third factor on C.

To find the value of 2·3×3·8×7·4, set 3·8 on Cr to 2·3 on D, move the cursor over 7·4 on C, and read the answer, 64·7, on D under the cursor line.

Division by two divisors is carried out by bringing one divisor on C to the dividend on D and reading the quotient on D under the second divisor on Cr.

To find the value of $\frac{19}{2\cdot7\times7\cdot2}$, place the cursor over 19 on scale D, bring 2·7 on C to it, move the cursor over 7·2 on Cr, and read 0·977, the required answer, on D.

Since the usual method of extracting square roots requires the use of the A scale, the accuracy is limited to that of the upper scales. A more exact method is to set 1 or 10 on Cr to the number on D—with this setting each pair of coinciding values on the two scales comprise factors of the number—and find the position on the two scales where the values are the same. This value is the square root. For instance, to find the square root of 835, set 1 on Cr to 835 on D, move the cursor along until the same value is found on Cr and on D under the cursor line. These coinciding points are at 28·9, which is, therefore, the required root. No difficulty will be experienced in placing the decimal point, if the number is first pointed off in groups of two figures. There must be

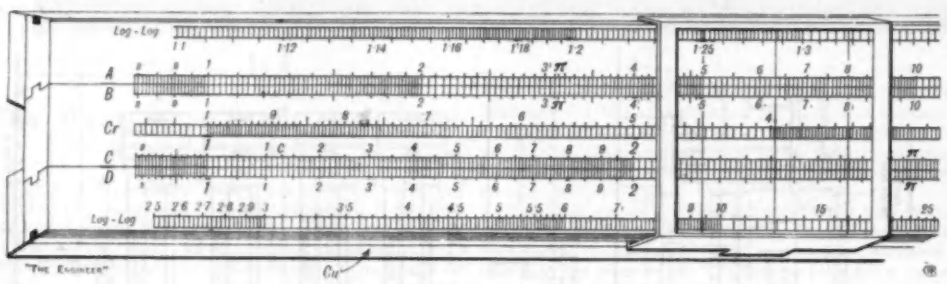
one figure in the root for each group in the number. The significant figures in any number have two square roots, depending on the position of the decimal point. It is, therefore, advisable to note roughly the square root of the first group in the pointed off number, thus ensuring that the wrong root is not read. When the coinciding values are found to give the wrong root, the other end of the slide must be set to the number. For even numbers of figures the slide projects to the right, for odd numbers of figures it projects to the left.

The reciprocal of the square root of a number is found by placing the cursor over the number on scale B and reading the answer on Cr. More accurately it may be found by determining the root with the Cr and D scales, as above explained, and reading the reciprocal on scale C in line with the coinciding graduations on Cr and D.

To find the value of $\frac{1}{\sqrt{23{\cdot}2}}$, place the cursor over 23·2 on scale B and read the answer, 0·208, on scale Cr.

By the second method, set 10 on Cr to 232 on D and read 0·208 on C in line with the point on Cr and D where the graduations have equal value. In either case the position of the decimal point is easily located, for $\sqrt{23{\cdot}2}$ may be taken as 4, the reciprocal being about 0·2.

Although a cube scale is frequently fitted to these slide rules, the following method of finding cubes and cube roots is often useful. To cube a number, set the number on Cr to the number on A and read the cube on A over 1 or 100 on B. By reversing this operation a cube root may be extracted. To find the cube root of 80, set 1 on Cr in line with 80 on scale A and move the cursor along until the same value is found under it on both Cr and A, reading only on the left-hand A scale. This value is seen to be 4·31, the required root.



MODERN ENGINEERS SLIDE RULE

If the number is larger than 1000, it should be pointed off in groups of three figures. The group on the left will contain one, two, or three figures, and the number of these figures decides where the number is on A and the direction in which the slide must project from the rule body :

To the left for one figure in the first group.
" " left " two figures " " "
" " right " three " " " "

In setting, one and three figures are taken on the left-hand A scale, and two figures on the right-hand. All roots are read on the left-hand A scale. These three cases are covered by the three simple numbers 8, 27 and 125. A trial setting, using one of these, will indicate the procedure in any case that can arise. When the number is decimal it can be changed into a whole number by shifting the decimal point three or six places to the right, it being moved back one place in the root for each three it was previously moved forward.

The scale of cubes makes possible the direct reading of cubes and cube roots of all numbers by simply moving the cursor over the number on the D scale and reading the cube on the cube scale, or reading the root on D in line with the number on the cube scale. This scale is graduated in three exactly similar portions, the first for units, the second for tens, and the third for hundreds. Thus, the question cannot arise as to whether a cube contains one, two, or three figures ; its position on the scale at once fixes the number of figures.

To find the cube root of 34,000, point the number off in groups of three figures from the right. This gives 34 000, showing that it must be treated as tens and taken on the centre portion of the cube scale, also that the root must contain two figures. Place the cursor line over 34 on the cube scale and read 3·24 on scale D. Two figures being required, the answer is 32·4.

Two-third powers, such as $354^{\frac{2}{3}}$, are simply determined with the cube scale, since they can be put into the form $\sqrt[3]{354^2}$. To solve this, set the cursor line over 354 on the hundreds portion of the cube scale and read the answer, 50, on the A scale under the cursor. Although the log-log scale may be employed for such examples, it is often more convenient to have the root on the ordinary scales to allow a further multiplication or division to be done.

Three-half powers are obtained by setting the cursor over the number on scale A and reading the answer on the cube scale. It is advisable to point the number off for square root before setting on the A scale ; one figure, in the first group, is taken on the left-hand A scale, and two figures are taken on the right.

To find the value of $730^{\frac{3}{2}}$, point the number into 7 30, place the cursor over 7·3 on scale A, and read 19·7 on the cube scale, tens portion. As there were two groups in the number, the decimal point must be shifted three places to the right—that is, two "cube" groups are required. Therefore the answer is 19,700.

A fifth power is found by setting the number on Cr to the number on D, and over the number on B reading the required power on A.

To find 40^5, set 40 (4) on Cr to 40 (4) on D and read 1024, the significant figures in the power, on A over 40 on B. In determining the number of figures, it is helpful to remember that $a^5 = a^2 \times a^3$, thus $40^5 = (4^2 \times 10^2)\ (4^3 \times 10^3) = 16 \times 64 \times 10^5$, and, roughly, $16 \times 7 \times 10^6 = 112 \times 10^6$. Whence the required answer is $102{\cdot}4 \times 10^6$.

With the above setting the square root of the fifth power, required in calculating the flow of water, steam, gas, &c., will be found on the D scale under the cursor line ; it is 10,120. The number of figures are very simply found from $\sqrt{100} \times \sqrt{10^6} = 10 \times 10^3$.

Very many combinations of roots and powers are possible on these lines, but the difficulty of estimating the number of figures in some cases diminishes the usefulness of these methods. Of course, where the number of figures is known beforehand, these scales are extremely convenient for such roots and powers as appear in formulæ. Where the number of figures is not easily determined, the log-log scale should be employed, since the decimal point will always be marked on the scale. But on this latter account the number must be of suitable size, though various artifices can be used to increase the range. As it is impossible to discuss log-log scales in this article, the reader is referred to the author's book, "Slide Rule Calculations" (Oxford University Press) for a detailed explanation and description of all the well-known types.

A few examples on the application of the foregoing methods to the evaluation of formulæ will be given.

To solve $Q = a\,L\,H^{1{\cdot}5} + b\,H^{2{\cdot}5}$, when $a = 0{\cdot}27$, $b = 28$, $L = 9{\cdot}5$, and $H = 0{\cdot}82$.

This requires to be solved in two portions and the results added. It is better to commence with the power in each case, and in order that the ordinary scales may be used, the formula should be changed to

$$Q = 0{\cdot}27 \times 9{\cdot}5\ \sqrt{0{\cdot}82^3} + 28\ \sqrt{0{\cdot}82^5}.$$

Set 0·82 on Cr to 0·82 (82) on A (the root, which is about 0·75, will be under 1 on scale Cr), move the cursor over 9·5 on the extension of scale C (the reading on D is about 7), bring 0·27 on Cr under the cursor and read 1·905 on D under 10 on Cr. It is convenient to note the approximate size of the numbers after each setting. Obviously, $0{\cdot}82^{1{\cdot}5}$ is between $0{\cdot}82^1$ and $0{\cdot}82^2$—*i.e.*, between 0·82 and, roughly, 0·64. The result would have been wrong had 0·82 been taken at 8·2 on A, since a number having the first significant figures immediately after the decimal point contains an even number of digits.

For the second part, set 0·82 on Cr to 0·82 on D, move the cursor over 0·82 on B, using the extra graduations to the left of 1 (the root under the cursor line on scale D is about 0·6), bring 28 on Cr to the cursor and read 17·05 on D under 10 on Cr, this reading being approximately $28 \times 0{\cdot}6$.

Therefore $Q = 1{\cdot}905 + 17{\cdot}05 = 18{\cdot}955$.

Find H.P. in the formula $H.P. = 10^{-13}\ p\ D^5\ N^3$, when $p = 1$, $D = 5$, and $N = 500$.

Substituting, $H.P. = 10^{-13} \times 1 \times 5^5 \times 500^3$.

Before calculating, the equation may be simplified as follows :—

$$H.P. = 10^{-13} \times 1 \times 5^5 \times 5^3 \times 100^3,$$
$$= 10^{-13} \times 10^6 \times 5^8 = 10^{-7} \times 25^4 = 10^{-7} \times 2{\cdot}5^4 \times 10^4$$
$$= 10^{-3} \times 2{\cdot}5^4.$$

Though every step is set down here for the sake of clearness, in practice this could be greatly shortened.

Set 2·5 on Cr to 2·5 on D and read the power, 39·1, on A over 100 on B. Therefore $H.P. = 39{\cdot}1 \times 10^{-3} = 0{\cdot}0391$.

Actually the position of the decimal point in the above answer would have probably been known in advance, and the preliminary rearrangement would have been unnecessary, the value of 5^8 alone being required. Had p any other value than 1, the answer would have been read on A over p on B.

Find the value of $0{\cdot}0115\ \sqrt{\frac{8000}{\sqrt{3}}}$.

Place the cursor over 8000 on scale D, bring 3 on B under it, move the cursor along until it is over the same value on Cr and D (this is seen to be about 68 on D, since it is the square root of, approximately, 4600 as found on D under 1 on C), without shifting the cursor bring 0·0115 on Cr to it and read 0·782 on D in line with 1 on Cr.

Evaluate the formula $c = 87\ \sqrt{\frac{1}{1 + \frac{3{\cdot}6}{1{\cdot}61}}}$.

Set 1·61 on C to 3·6 on D and read 2·24 on D under 1 on C. To this add 1 and bring 3·24 on B to 1 on A, move the cursor over 87 on C and read 48·4, the required value, on D.

The position of the decimal point was clearly seen at each step, since $\sqrt{\frac{1}{3{\cdot}24}}$ is about $\frac{1}{2}$, and thus the answer is approximately $87 \times \frac{1}{2}$.

Find the value of $W = 48{\cdot}4\ \sqrt{\frac{0{\cdot}3633 \times 1{\cdot}61^5}{2000}}$.

Bring 1·61 on Cr to 1·61 on D, put the cursor over 100 on B and bring 1 on B under it (this is necessary because 1·61 on B is too much to the left), move the cursor over 1·61 on B, bring 2000 (20) on B under the cursor, move the cursor over 0·3633 (36·32) on B, bring 10 on C under the cursor and read 2·14, the required answer, on D in line with 48·4 on C. The position of the decimal point should not cause difficulty : $1{\cdot}61^5$ is about 10 ; $\frac{10}{2000} = \frac{0{\cdot}01}{2} = 0{\cdot}005$; $0{\cdot}005 \times 0{\cdot}3633 = \frac{0{\cdot}005}{3}$ (approximately) $= 0{\cdot}002$; $\sqrt{0{\cdot}002} = 0{\cdot}04$ about ; $48{\cdot}4 \times 0{\cdot}04$ is about 2. It is convenient in such estimates, which are, of course, done mentally, to imagine the decimal points in any suitable position. For instance, $48{\cdot}4 \times 0{\cdot}04$ is simpler as $0{\cdot}484 \times 4$, it being considered as $0{\cdot}5 \times 4$.

The cursor, having two or three lines, which is now generally supplied with engineers' slide rules, enables calculations relating to areas and volumes of cylinders, spheres, &c., to be carried out with great ease. The space between the centre line and one of the outside lines is usually made equal to $\frac{4}{\pi} = 1{\cdot}273$, this length being measured by the graduations of the upper scales. When the right-hand line is over the diameter of a circle on D, the centre cursor line will give the area on scale A. Conversely, when the centre line is on the area on A, the right-hand line indicates the diameter on D.

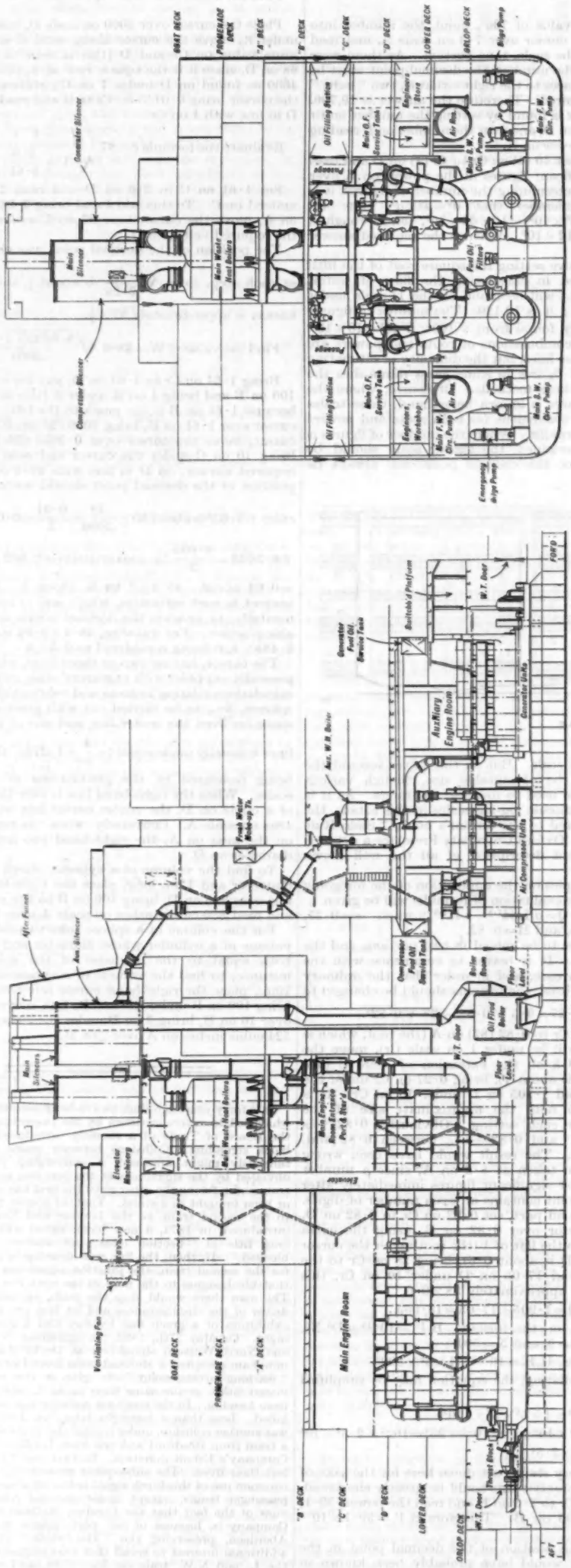
To find the volume of a cylinder which is 9¼in. in diameter and 12in. long, place the right-hand cursor line over 9·5 on D, bring 100 on B to the middle line, and read 850 cubic inches on scale A over 12 on B.

For the volume of a sphere take two-thirds of the volume of a cylinder whose diameter and height are both equal to the diameter of the sphere. For instance, to find the volume of a sphere of diameter 10in., place the right-hand cursor line over 10 on C, bring 100 on B under the middle line, move the cursor over 10 on B, bring 3 on B under the cursor and read 524 cubic inches on A over 2 on B.

It is forty years ago since two railway accidents occurred which led to severe criticism by the inspecting officers of the Board of Trade of a recently introduced feature in block signalling. Collisions between trains that simultaneously might approach a converging junction are obviated by the signalman at the junction accepting one train and refusing the other until the first has either passed or been brought to a stand. That, of course, meant delay to the second train, so the London and North-Western introduced, in 1874, a new block signal which bore the long title of "Section clear, but station or junction blocked." If, then, the line was clear up to the junction for the second train, the junction signalman would send that block signal to the man in the next box in the rear. The man there would stop the train, verbally warn the driver of the circumstances and let him proceed with the exhibition of a green flag by day and a green light by night. On May 27th, 1892, the signalman in the London and North-Western signal-box at Derby Junction, Birmingham accepted a Midland train from Derby under the "warning arrangement"—to give it the usual abbreviated title—at the same time as an L. and N.W. train from London. In the resultant collision one passenger was killed. Less than a fortnight later—on June 9th—there was another collision, under similar circumstances, between a train from Bradford and one from Leeds at the Midland Company's Esholt Junction. In that case five passengers lost their lives. The subsequent protests against the too common use of this block signal led to its abandonment for passenger trains, except under unusual conditions. In view of the fact that the London, Midland and Scottish Company is, because of her performance in the race to Aberdeen, preserving the "Hardwicke," it will be of additional interest to recall that that engine was drawing the L. and N.W. train on May 27th, and was knocked off the line by the Midland engine and fell over the parapet wall of a viaduct into the street, 40ft. below.

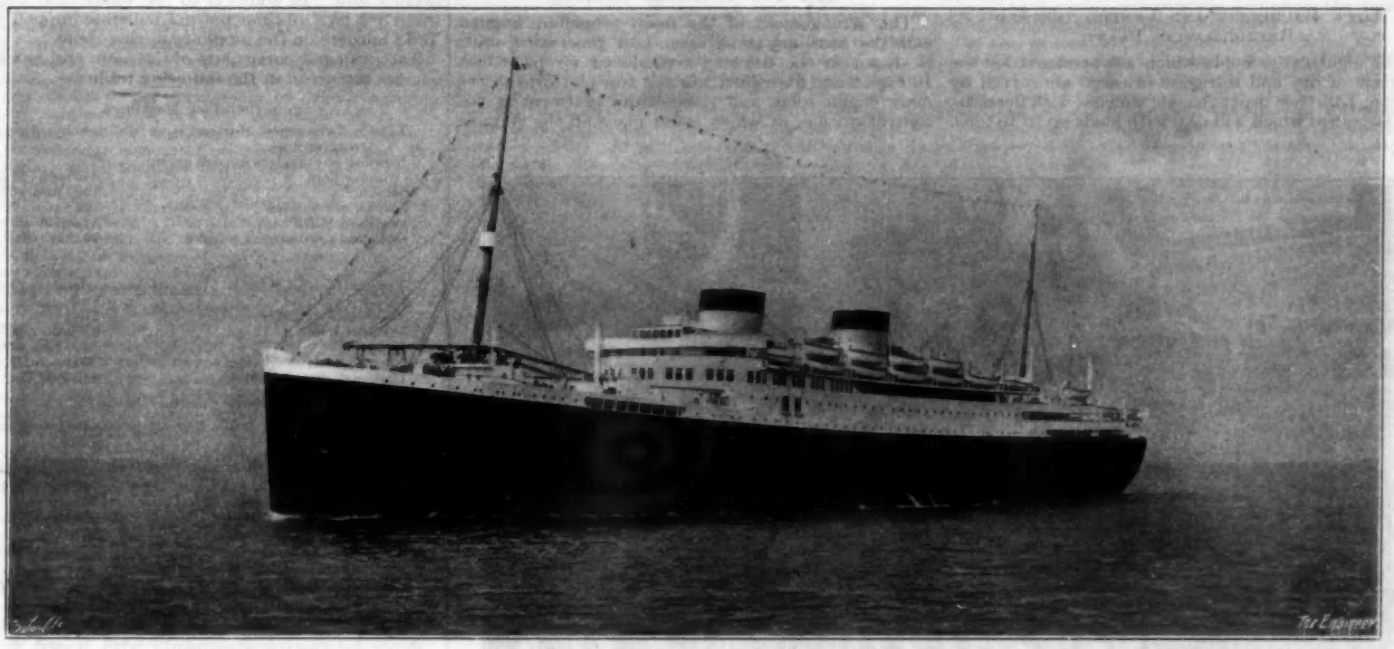
M. V. "GEORGIC"—ARRANGEMENT OF MAIN AND AUXILIARY ENGINES

(For description see opposite page).



THE WHITE STAR MOTOR LINER "GEORGIC"

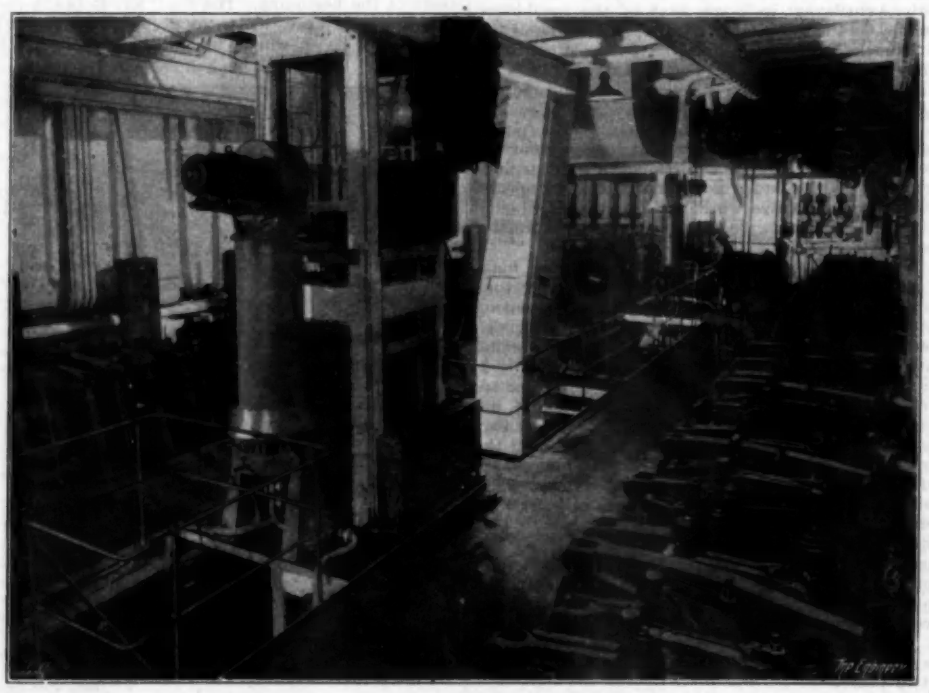
HARLAND AND WOLFF, LTD., BELFAST, BUILDERS AND ENGINEERS



The White Star Motor Passenger Liner "Georgic."

THE new White Star liner "Georgic," sister to the "Britannic," and, like that ship, designed, built, and engined by Harland and Wolff, Ltd., at Belfast, arrived at her home port, Liverpool, on Monday last. She is scheduled to start on her maiden voyage to New York on Saturday, June 25th. After the successful completion of her official trials last week, her owners invited a large company of guests representing shipping, financial, and commercial interests to join the ship at Belfast and come round on her to Liverpool. The party left London for Liverpool on Saturday evening and crossed to Belfast Lough in the Ulster Imperial Line motor ship "Ulster Prince," reaching their destination early on Sunday morning. The "Georgic" was lying off the mouth of the Lough and was reached by tender, after which she sailed about 8.30 a.m. for the Firth of Clyde, reaching Arran and the Little Cumbrae Island on Sunday afternoon. In the evening she turned again south and followed the coast until the Mersey Bar was crossed in the early hours of Monday morning. The "Britannic" arrived in the Mersey from New York the same morning and we were interested to learn that she carried over 1300 cabin, tourist, and third-class passengers and is assured of a full complement for her next eastward voyage. In this respect the "Georgic" bids to be no less popular, and already some 1400 passengers have announced their intention of travelling on her on her maiden voyage.

These two liners are without any doubt two of the most important ships added to the British mercantile fleet during recent years. They mark a most successful effort on the part of the builders to produce a vessel which, whilst embodying all possible safety and navigational facilities, offers a maximum of comfort at a minimum cost of operation. This fact is convincingly brought to mind by a small ¼in. diameter glass tube



TOP PLATFORM IN MAIN ENGINE ROOM

filled with 1¼in. of fuel oil, which is displayed at the entrance to the main engine-room top platform, with the accompanying statement that this small quantity of fuel is sufficient to transport 1 ton for 1 mile at the full speed of the ship.

In our issue of June 27th, 1930, we gave a full and detailed account of the hull and machinery of the "Britannic," and it is hardly necessary to state that in most respects the "Georgic" and she are identical. In what follows we propose to confine ourselves to a more general account of some of the outstanding features of the ship and her engines, stressing more particularly the newer features which, after two years' successful operation of the "Britannic," have now been embodied in the design of the "Georgic."

HULL DESIGN AND EQUIPMENT.

The principal dimensions and the passenger-carrying capacities of the new liner are as follows :—

Hull Particulars.

Length between perpendiculars	680ft.
Breadth moulded	82ft.
Depth moulded	43ft. 9in.
Loaded draught	34ft. 3½in.
Designed sea speed	16 to 17 knots
• Gross tonnage	About 27,000

Passenger Accommodation.

Cabin class passengers	479
Tourist-class passengers	557
Third-class passengers	596
Total	1632

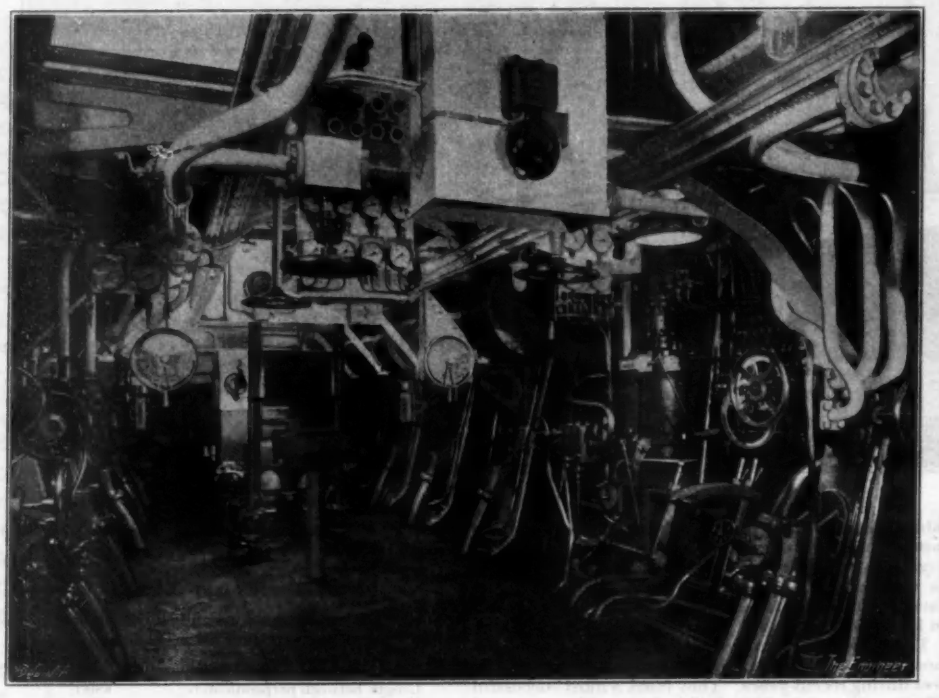
The general appearance of the ship will be seen from the accompanying photograph, which was taken by Mr. Stewart Bale on Monday last as the "Georgic" came up to the Liverpool Landing Stage. It shows very clearly her pleasing lines and superstructure, which are enhanced by her straight stem and cruiser stern, her two tall, well-raked, masts, and two broad low funnels. The forward funnel is a dummy and in addition to accommodating part of the smoke room for the ship's officers, it houses the wireless room and forms a convenient metal screen for this apparatus. There is an observation platform 3ft. or 4ft. below the edge of the funnel, on which is mounted the directional finding wireless aerial. This funnel platform forms an excellent vantage point from which to view the ship. Attention may also be directed to the curved bridge front with flared lip, ensuring wind-still conditions on the open wings of the bridge. The adoption of a curved design has also made possible a roomy palm court and observation room at the fore part of the ship adjacent to the main promenade deck and the principal public rooms.

The ship was built under Lloyd's special and Board of Trade surveys and embodies all the most recent requirements for safe navigation and freedom from fire risks. The hull is divided into thirteen watertight compartments and there is a double bottom running practically the whole length of the ship, in which the fresh water, oil fuel, and water ballast spaces are arranged. The Harland electrical watertight door system is fitted throughout the compartments and is so designed that it can be controlled from the bridge and worked either from the auxiliary generators or the emergency generator set. As may be noted from our engraving, the lifeboats are carried in single and double-nested grouping in twenty quadrant davits of the Welin-Maclachlan pattern with electrically-operated boat hoisting gear. The steering gear is of the Harland and Wolff-Hastie electric-hydraulic type, with Hele-Shaw-Martineau pumps and motors in duplicate. They are directly controlled from the bridge through MacTaggart-Scott telemotor gear embodying the Clay patented safety steering device. The compasses are of the standard Sperry Mark VIII. gyrostatic type with repeaters, and we noted that the navigating equipment included most of the modern devices for safe navigation. "Willett-Bruce" triple bell whistles with hand and electric controls are fitted on the forward mast and the after funnel, and as these are

worked by compressed air a steam puff valve to give a visible as well as an audible signal is included. We have already referred to the arrangement of the wireless equipment in the forward dummy funnel; this is of the latest Marconi 1½-kW type with long and short-wave transmission and direction finding gear.

Deck Machinery and Ventilating and Refrigerating Plant.

The eight cargo holds which are arranged for the carriage of dry and refrigerated cargo are served by sixteen Laurence Scott electric winches with derricks, the largest of which will deal with loads up to 10 tons.



BOTTOM PLATFORM SHOWING STARTING AND MANŒUVRING CONTROLS

The boat lowering winches are also of the Laurence Scott silent type, while the capstans and windlasses incorporate in their design Clarke Chapman's latest practice in electrically-driven deck machinery. The ventilating and heating plant is exceptionally complete, in view of the varied service of the ship, which, in addition to North Atlantic voyages, may be required for northern and tropical cruises. There are in all about eighty-five pressure fans, ranging in diameter from 10in. to 60in., over forty of which are fitted with heating elements for use in cold weather. The air heating or cooling fan units are of the Pleno unit type, supplied by the Winsor Engineering Company, Ltd., of Pollokshaws, Glasgow, and work in conjunction with directional louvre fittings in the state rooms and public rooms. The refrigerating plant was supplied by J. and E. Hall, Ltd., of Dartford, and comprises two vertical high-speed motor-driven CO_2 compressors with the usual condensers, evaporators, and electrically driven brine and water pumps. The Harland motors have a designed output of 90 B.H.P. with a variable speed of 375 to 200 r.p.m. The sets, which are quiet in operation, are fitted with intermediate liquid cooling gear with compressor supercharging, which is an arrangement for increasing the efficiency and the duty of the machines when they are working under extreme conditions with high sea temperature and low brine temperature. The gear consists of a receiver with an automatic float control gear, through which the CO_2 liquid passes on the way to the brine evaporator. The insulated cargo spaces include 'tween deck spaces aggregating some 83,600 cubic feet, in addition to which there are additional brine-cooled and air-cooled spaces for domestic services. The refrigerating plant is placed at the forward end of the auxiliary engine-room.

Public Rooms and Cabins.

In designing the public rooms and passenger accommodation full advantage was taken of the experience gained with the sister ship "Britannic," both on Transatlantic and cruising voyages. It was decided to make a distinct difference in the decoration of the two liners by making a departure from the free period style employed in the "Britannic" and adopting in the "Georgic" a modern style of decoration. The work was entrusted to Mr. Ashby Tabb, of Heaton, Tabb and Co., Ltd., of London and Liverpool. In his work Mr. Tabb has been greatly aided by the builders' illuminating engineers, and the novel indirect lighting of the public rooms and the promenade decks was greatly admired by the visitors. For the first time, we believe, an electrically operated Colorama apparatus is used aboard the ship for suffusing and intermingling colour in the roof lighting effects of the lounge.

The provision of the circular palm court with the long gallery illustrated herewith, leading to the combined smoke room and verandah, are new features of interest. The dining saloons and the state rooms in all classes attain fully that high standard which we have come to associate with the builders' work.

Main and Auxiliary Engines.

The arrangement of the main propelling engines and the auxiliary compressor and generating units is shown in the drawing reproduced on page 660. In Figs. 2 and 3 we illustrate the top platform in the main engine-room and the bottom platform at the control station, at which latter place all the starting and manœuvring controls are arranged. The general lay-out of the machinery, as will be gathered from the drawing on page 660, gives easy access to all auxiliaries, and we were impressed by the excellence of the ventilation in every part of the machinery spaces. On the top platform will be seen some of the "Stannock" air heaters, which have been supplied by Sturtevant Engineering and Pochin, Ltd., of Leicester, and which furnish heated air at various points in the engine-room. Ample lifting gear has been provided, we noted, for handling large and small engine parts, and the workshops in the main and auxiliary engine-rooms carry a well-chosen assortment of tools, including lathes, shaping and grinding machines, with special attachments for valve work, along with large bench accommodation and conveniently arranged stores for spare parts.

As in the engines of the "Britannic," the main cylinders are cooled with fresh water, while the pistons are oil cooled. Calorifiers for heating the circulating water are fitted. Automatic Monitor alarms of both flow and pressure type are fitted, while at the starting platform illuminated signals indicate when the circulating pumps for fuel oil, lubricating oil, and water are in operation. Most of these pumps, we observed, are of the Drysdale "Centrex" pattern, with motors supplied by the builders. Over these pumps in the engine-room wings are placed the reservoirs for starting and manœuvring air. Attention may be directed to the installation of "Uneek" sand filters with arrangements for chlorinating the drinking water. This installation, which was designed and built by the Turnover Filter Company, Ltd., of Belfast and London, is practically a duplicate of that fitted on the "Britannic," which, we were informed, has given excellent service, and beyond a few shillings a voyage for chemicals, has required practically no upkeep, the sand not requiring to be changed during a period of two years.

In the auxiliary engine-rooms a modified arrangement of water circulating pipes has been adopted and has given greater flexibility in the operation of the individual compressors and generator sets and also allows sea water to be utilised for cooling in the remote case of the fresh water supply being cut off. Few ships have such a large installation of Clarkson thimble-tube waste heat boilers for both main and auxiliary engines, which are conveniently arranged in the engine-room uptakes below the silencers. There are two large boilers, each designed to deal with the exhaust gases from one main engine and two further smaller boilers for the compressor units and auxiliary generator sets. The boilers are of the latest jointless pattern and those for the main engines are each designed to produce over 5000 lb. of steam per hour, the two auxiliary boilers each having a designed output of 1800 lb. The large boilers are 9ft. 10in. in diameter and 16ft. high and the smaller 6ft. 9in. in diameter and 11ft. 6in. high. Steam is generated at a pressure of 100 lb. per square inch and is largely utilised in the Winsor-Pleno heaters, previously referred, to for warming the ventilating air, thereby marking a further development in heat economy aboard ship. In addition to the waste heat boilers, there are two oil-fired marine boilers equipped with Todd burners, in the auxiliary engine-room.

The principal particulars of the main and auxiliary engines are given in the following table:—

Main Propelling Machinery.

Type: Twin-screw, Harland-B. & W., double-acting four-stroke motors	
Number of cylinders in each engine	Ten
Cylinder bore	840 mm. (33 1/16 in.)
Stroke	1600 mm. (63in.)
Service revolutions	102 r.p.m.
Designed M.E.P.	About 90 lb./sq. in.
Designed total service output	20,000 S.H.P.

Air Compressor Sets.

Type: Harland-B. & W., four-stroke, single-acting motors	
Number of units	Four
Number of cylinders each engine	Four
Cylinder bore	550 mm. (21 5/8 in.)
Stroke	1000 mm. (39 3/8 in.)
Normal running speed	160 r.p.m.
Designed output each set	850 B.H.P.

Auxiliary Generator Sets.

Type: Harland-B. & W., four-stroke, single-acting motors	
Number of units	Four
Number of cylinders each engine	Six
Cylinder bore	500 m.m. (19 11/16 in.)
Stroke	750 mm. (29½in.)
Normal running speed	160 r.p.m.
Generator output each set	500 kW
Voltage	220 volts

Emergency Generator Set.

One 75-kW Harland-B. & W. oil engine-driven generator

The Trial Trip Dinner.

Some interesting statements with regard to the present shipbuilding position were made at the dinner on board on Sunday evening, June 12th, when Mr. A. B. Canty, director and general manager of the White Star Line, took the chair and welcomed the guests. In his speech he acknowledged the services of the financial authorities who were helping the company, and expressed his full confidence in the recovery of the financial fortunes of the line as soon as the international position had bettered itself. The Lord Mayor of Liverpool and Mr. William Gourlay responded on behalf of the guests. General Sir Arthur Maxwell, in proposing "The Success of the 'Georgic,'" pleaded for a healthy optimism which should be cautious and well reasoned. In his reply, Mr. F. E. Rebbeck, the chairman of Harland and Wolff, Ltd., referred to the cost of the ship, which, he indicated, had worked out considerably less than had appeared likely at the beginning. His firm, Mr. Rebbeck continued, was in a position to supply ships on a strictly competitive basis, which, like for like, could not be

VIEW IN THE LONG GALLERY

bettered in the world. He paid a warm tribute to the help given to him by his technical staff and men, and the friendly collaboration of the owners. Mr. Rebbeck stated that in a period of sixty-two years, which marked the beginning of relations between Harland and Wolff, Ltd., and the Oceanic Company, his firm had supplied no less than seventy-seven ships with a total of nearly 900,000 gross tons. Referring to the present, Mr. Rebbeck said that shipbuilders could not stand still, and to-day his firm was carefully studying the "Georgic" to see what new features could be embodied in the next ship. Brief reference was made to the performance of the ship on trials, and we hope that at a later date some authentic performance figures will be published.

Stainless Iron and Steel Production.*

No. 1.

STAINLESS irons and steels are essentially alloys of iron and chromium. There are many stainless irons and more stainless steels. The common property of the conventional product is chromium in amounts usually exceeding 10 per cent. The conventional range of chromium is usually over 10 and under 20 per cent. Chromium is quite common. The usual source is the mineral chromite, usually designated by the formula Fe 0 . Cr 203. Pure, it would contain 68 per cent. chromium oxide; commercially it is closer to 50 per cent. chromium oxide, with an extremely wide variation in chemical composition. The present large sources of ore are Rhodesia and New Caledonia. Small tonnages of the mineral are produced in many parts of the world. It has been estimated that the earth's crust at the surface contains 5 per cent. iron, and the same estimate places the amount of chromium as 0·066 per cent. We may reasonably estimate the supply as being far in excess of visible demand.

The commercial conversion of chromite to stainless steels is by one of two fundamental channels. Either the ore is smelted to a concentrated ferro-alloy and added to the steel or the ore is reduced directly during the steel-making operation. Thus, we hear of ordinary steel practice and the so-called direct reduction methods.

Direct reduction methods are of general interest and some discussion of the fundamentals involved should be included. For this reason two which have been the source of product on a commercial scale will be mentioned. Chromite, the usual ore, is very similar in many ways to iron ore. It is natural that all of the existing methods of reducing iron ore should have been tried to reduce chromium oxide. Two have been more than experimentally successful. Sponge iron has been duplicated by sponge chromium and arc electric furnace reduction has been duplicated by arc furnace reduced chromium. The sponge iron methods have not reached the scope of the electric furnace methods. One process combines the reduction to sponge and melting as a single process. No metallurgical obstacle exists to the direct reduction methods and it has been demonstrated that satisfactory product can be made.

In the better-known method—that is, direct reduction in the arc electric furnace—the bath of steel scrap is melted and the chromium added as chromite to a slag, mainly lime, and the reduction accomplished by means of some reducing agent, usually silicon. The process is not as simple as it sounds, since the temperature at which the chromium will eliminate carbon from the bath is much higher than usual. The absorbing power of the bath for carbon is so high and the material so sensitive to small amounts of carbon that usual furnace practice does not accomplish the result. The writer has no knowledge of the maximum size heat of direct reduced stainless made, but feels that with conventional arc furnace equipment bottom materials will determine the limit and that about 5 tons will be the maximum working charge. This provides for a considerable production. The higher the chromium content of the steel and the lower the carbon the more difficult the operation, and it may be judged that it would be a battle between sufficient chromium, low enough carbon and the cost sheet. A great many satisfactory direct or semi-direct reduction methods exist for very small furnaces, but no serious tonnage of direct reduced material has been made in large furnaces.

A compromise method which is satisfactory in small furnaces is to add high carbon ferro-chromium, oxidising the carbon at a very high heat and cooling the bath by scrap additions before tapping. The compromise methods seem to offer more promise and the ultimate method will be based upon economics, since the metallurgy of the various processes is commercially satisfactory.

The ferro-alloy method is the commercial tonnage method, and appears to be sounder metallurgically as well as economically. In this method the chrome ore of smelting quality is delivered to ferro-alloy smelting plants usually located at points of very cheap power. The reduction to ferro-chromium is done on a large scale and the material graded to meet the varying requirements. Ferro-chromium with as low as 0·06 carbon is possible in large amounts and above 0·20 carbon any quantity desired would be available.

The cost of such smelting should always be competitive with the same reduction at points where power is more expensive. The resulting ferro-alloy can be shipped any distance with no problem other than freight. The choice of direct reduction *versus* ferro-alloy addition has much of the logic on the side of the ferro-alloy addition.

OPERATION OF THE FURNACE.

The arc electric furnace used in stainless production does not differ in any respect from that used for conventional electric furnace steels. The size of the furnace used is determined by the average requirement rather than by any limitation of process. Ordinary stainless products could be produced in the largest electric furnaces now existing, and are regularly produced in 25-ton units. The usual order requirement seldom exceeds the capacity of the 15-ton unit and this, or smaller sizes, is more commonly used.

A charge of as low carbon material as is available is melted down, and if the carbon content is not below 0·06 the bath is oxidised until the carbon content is satisfactory. The heat is slagged off. More than ordinary care is taken in this operation to remove all slag possible. The alloy additions which are to follow are expensive and easily held if the slag is oxidised. Every precaution should be taken to prevent loss, and since one of the most effective precautions is the preparation of a low carbon heat and a proper slag-off, this is usually very well done.

The low carbon heat must be covered with a new slag. This is done by using burnt lime and ferro-silicon. When the heat has been under the new slag long enough to shape up and develop proper temperature ferro-chromium is added. If the shaping of the heat has been done carelessly, judging the temperature of the bath is a problem. The ferro-chromium addition is so large a proportion of the total that expert temperature observations are of exceeding importance. The ferro-chromium is usually added in two batches. The slag becomes a crust and often lumps of the ferro-alloy lie loose on the frozen crust. When the power is put on, the whole melts quickly, and there is a definite tendency to develop high heat very rapidly. At this stage the condition of the heat determines the ability of the operator to properly judge temperature.

When the heat is ready it is tapped into the ladle and poured in a conventional manner. In the making of simple steels certain precautions such as tight furnaces, good roof, good bottom conditions, are observed. In stainless manufacture the equipment conditions are much more important. Stainless alloys are subject to many variables. A very interesting sidelight may be conveyed by recounting the experience reported by one foreign manufacturer. Persistent trouble in one grade of stainless was finally run down to leakage of air into the furnace about the doors. Nearly a year was needed to pin down the fact that the furnace must be under positive pressure as much as possible. Stainless of any grade seems to mask the usual signs, and it has been the experience of many skilled melters that heats of stainless may be made, poured and no evidence of trouble appear till the metal has been in the moulds many minutes. All grades are extremely sensitive to moisture either in the materials or about the furnace.

A great many designs of moulds have been used to cast stainless ingots. When it is considered that the usual stainless is a dead steel with the tendency to form extremely large crystals it will be understood that casting is more than an ordinary problem. Stainless ingots are designed first with the idea of protection of the fragile surfaces, and secondly, with a view to overcoming rolling difficulties. An ingot based somewhat upon the section considered ideal by Benedicks—that is, one in which the concave faces of the ingot are so shaped that the shrinkage causes the corners to pull away from the mould—has been successful in practice. The chill crystals forming in the corners are very fragile, and the Benedicks type of ingot causes the corner chill to cease quickly. Fluted ingots with the flutes so designed that flute cracks are avoided are useful. For flat rolled products a slab modification of the Benedicks ingot has produced many tons of very satisfactory material. The circular ingots of some of the foreign plants which were turned all over before rolling were peculiar to their conditions rather than necessary by virtue of the character of the product.

The chrome nickel stainless iron of the austenitic, or tough, type used for decorative work or simple corrosion resistance is the simplest to handle. There does not appear to be any limit to the ingot size with this material. Thirty-ton ingots have been produced. Larger ingots are not only possible, but sensible. The straight chromium iron type for simple corrosion work has also been cast into ingots of several tons, but this type is sensitive to surface cracking, and is not nearly as easily handled. Any of the usual stainless irons may be handled in ingots up to 10 tons for rolling and forging. From these large ingots the gradation is to very small ingots. The higher carbon ranges of complicated alloys require very small ingots. The heat-resisting steels—of, say, twenty-five chromium, twenty nickel group—are best handled in ingots less than 15in. across. The very hard stainless steels, such as the stainless ball steels, are best in ingots less than 10in. across. No single ingot will handle all the requirements. The various combinations of steel, ingot, and method of working that give results have been determined mainly by trial and error.

It has seemed that the major difficulty encountered in production of stainless on a large scale, is the acute problem of handling a material which requires a very small unit in its prime production. Until normal size ingots—that is, 2 or more tons per ingot—are feasible in all combinations of chemistry, stainless will be handicapped by other factors than the cost of raw materials. Until the actual production problems encountered in handling assorted size ingots—some of which are forged, others rolled, some partly forged and then rolled—have been faced, no clear idea of the special character of these steels is gained. The most important stage in the making of any stainless heat is the selection of ingot section and the handling from the casting through to the first stages of working.

The chrome nickel stainless irons of the austenitic type may be cooled directly in the mould and handled quite easily. This type of material may be produced far in advance of requirements and stocks of ingots of this material totalling several thousand tons are not uncommon. No serious problem is encountered in picking up cold ingots of this type for rolling. It may be considered the exception that proves the rule. The other grades of stainless are subject to cracking during cooling and reheating. It is possible to handle small ingots for forging. Large ingots are annealed or cooled very slowly. The risk involved is too great to encourage large ingot production aside from those to be rolled as soon as possible after casting. For this reason it is exceptional to encounter any large stock of stainless in ingot form except in the austenitic types as outlined above.

STAINLESS SCRAP.

Since it is impossible with our present knowledge to pour any ingot of stainless into a shape that will permit complete use of the material, we face the problem of handling scrap. This is not peculiar to the stainless industry, nor does it stop at handling of the ingot. Scrap is produced at each stage of working. The peculiar condition involved in stainless scrap is its high value. The simple chromium materials have a scrap value in excess of the value of many ordinary steel products. The complex alloys produce scrap whose alloy content far exceeds the cost of ordinary steel products. The economic value of the family of stainless steels is such that an attitude very similar to that encountered in non-ferrous metals must be developed. At every stage of the operation attention must be drawn to the value of the product, or the crews will consider it as any other steel. The remelting of this scrap into low carbon grades with conventional equipment has been difficult. It can be reworked without special furnaces, but at the expense of compromise between the desired low carbons and a product which can be produced on a commercial basis. To rework the scrap as produced and not be forced to compromise on the desirable carbon limits, the melting system must be carbon free. The conventional arc electric furnace is thus ruled out. The satisfactory unit is the induction furnace. Stainless production on any large scale virtually requires as an auxiliary an induction unit and it is very questionable whether in the future the induction furnace will not be the prime unit with the arc furnace the standby for the small special lots that are required.

In the case of the austenitic chrome nickel type an important reason exists for the use of the induction furnace. The austenitic steels are extremely satisfactory welding steels, since they produce ductile soft welds. These welds are subject to reduced resistance to corrosion if the carbon separates as chromium carbide. The condition is known as weld embrittlement and has been the subject of much discussion.

Without attempting a scientific study of this phenomenon, it may be described as a condition which causes the grains to be surrounded by the carbide phase which lacks ductility and produces an adjacent ferrite which is easily soluble in many acids. A defective weld is thus brittle and will not resist attack. Remelting in an induction unit is the positive method of converting low carbon material and not raising the carbon. Very low carbon is excellent insurance against welding troubles. Remelting in the arc furnace involves carbon pick up. An average of five points is common if the scrap has been low carbon—that is, less than 0·10. As the general level approaches 0·16 it is not difficult to maintain an upper limit a point or two above the scrap. With induction remelting a steady flow of material less than 0·12 can be maintained.

REHEATING.

All the stainless steels are highly alloyed and as such are remarkably low in their rate of heat conductivity. The thermal history after solidification is, therefore, different at least in time element, from simple steels. A hot ingot of 18 chromium 8 nickel, 17in. by 20in. in size, requires about 9 hours of extremely careful heating before rolling. Any attempt to push or rush is paid for in surface defects. The 18 per cent. chromium is easier to handle, but requires double the heating time of the ordinary alloy steel. The future heating arrangement for these steels will most likely be the one-way fired recuperator equipped pit. The very satisfactory quality of heating possible in this type of unit is easily shown with these steels. The very long cycles will demand insulation and recuperation of the highest quality.

Nearly all this family of steels are heat-resisting in that they scale very slowly. They are difficult to heat because they have very narrow ranges in which they must be soaked if they are to roll. Pyrometric measurement of temperature is so essential that it has become standard. The chrome nickel of the 18 chromium 8 nickel type is subject to a varied set of limitations. When low in carbon it is a two-phase material as cast, the magnetic delta phase being present along with the non-magnetic gamma phase. If the ingot has been permitted to become cold, the heating up to red must be done slowly enough to prevent rupture of a very coarsely crystalline material with a very low conductivity. After the ingot is hot enough to ensure ductility the temperature can be increased fairly rapidly, but an upper limit of 2300 deg. Fah. must be observed. The delta phase present as cast must be put into solution. This starts at 1800 deg. Fah. and is rapid at 1950 deg. to 2250 deg. Fah. Above 2300 deg. Fah. the reaction reverses and the delta appears again to produce a very hot short material. Since no surface evidence is visible the pyrometer must be used and depended upon. If high temperature is not used the low thermal conductivity causes a long heating cycle; if the top temperature is exceeded the destruction is very rapid. The customary heating time from cold to rolling temperature is well in excess of 1 hour per inch cross section. Ingots 17in. by 20in. are regularly under fire more than 24 hours if they have been cold. Hot ingots of the same size charged in the pits about 1½ hours after pouring, require 9 hours heating to ensure good rolling.

The straight chromium irons are simpler to work, since they act more like ordinary steels, except for their low conductivity They are subject to the limitation that rolling must be done rapidly to conserve heat. The exposed portions cool and the low thermal conductivity causes the outer portions to remain low in temperature. Since all of these highly alloyed steels are much stiffer for any given temperature, cracking starts quickly, due to lack of ductility. While the straight chromium irons are fairly easy to work, all the other members of the stainless family are difficult to roll. The addition of silicon to these steels causes an increase in handling difficulties. The addition of the many other elements causes really serious complications. To call attention to the problems an example may be given by a discussion of a chromium-nickel-tungsten of the type of 18 chromium 8 nickel and 3 tungsten. This steel is stiff, and there is a tendency to heat high to hasten the production. If the heat is raised the product promptly breaks up. The upper range for working may in some cases be as high as 2100 deg. Fah. if the manganese is over 1 per cent. The lower range at which the stiffness causes breakage is about 1900 deg. This narrow range does not permit rolling in the accepted sense. Forging is resorted to in breaking down the ingot. Rolling in the bar stages must be done in lengths and sizes that will permit finishing in the temperature range which permits working. To determine the working ranges and adapt the equipment to them, has been a trial and error development.

The 18 chromium 8 nickel austenitic series work over a wide range as noted above. Power to move is nearly the only factor if the steel has been soaked carefully. The 18 chromium series work over wide range, but do not work if the surfaces are decarburised to any serious depth.

With the exception of silicon in amounts less than 1 per cent., additional alloying usually narrows the working range of the 18 chromium or the 18 chromium 8 nickel to a point where forging is more satisfactory. The high chromium 25/28 per cent. chromium is better forged, using many heats and working from 2000 deg. to 1850 deg. Fah. The 25 chromium 12 nickel 1 silicon series is forged from about 2150 deg. to 1900 deg. Fah. The 25 chromium 20 nickel is forged from 2200 deg. to 2000 deg. Fah. In

* From a paper by E. C. Smith, of the Republic Steel Corporation, Massillon, Ohio, read before the American Iron and Steel Institute, at New York, May 19th, 1932.

all cases the forging must be done in a manner that prevents exposed corners. The usual practice is to go over the entire ingot surface lightly, working in any exposed corners. The usual working shape is an octagon or a round-cornered octagon. A great number of heats are taken to ensure working well within the ductile range. With all precautions the surface is usually far from desirable.

(To be continued.)

The Advertising Convention.

AT the opening general session of the Advertising Convention in Liverpool on Monday, June 13th, Colonel Sir James Reynolds delivered an address on the theme "Advertising in Britain's Year of Opportunity."

In it he said "At Ottawa there will be a greater concentration of thought on Empire interests than ever before. This year of 'Britain's opportunity' must not be allowed to pass without signal action. The opportunity of Ottawa must not be a lost opportunity. The opportunities are wonderful, transcending those of any other nation, and it is not too much to say that the whole future of our race depends on the bold and vigorous application of the principles of Empire economic unity. There, there will be trade represented which, if only turned homewards, could enable every efficient factory in this country to work full time. There will be offered food and raw materials to supply nearly all our requirements which can be taken in payment for our goods. A great trade in barter awaits us, rendering the Empire all sufficient economically. The goodwill will be there, help us to do all we can to foster it. We trade across the seas rather than by land routes, let us see to it that British ships are our vehicle and Liverpool will come into her own again. If all the power, initiative and patriotism that lie enshrined in this great gathering be turned towards reconstruction and self-help within the Empire, then a successful Ottawa will be assured and a fresh dawn of hope will shine on the British race."

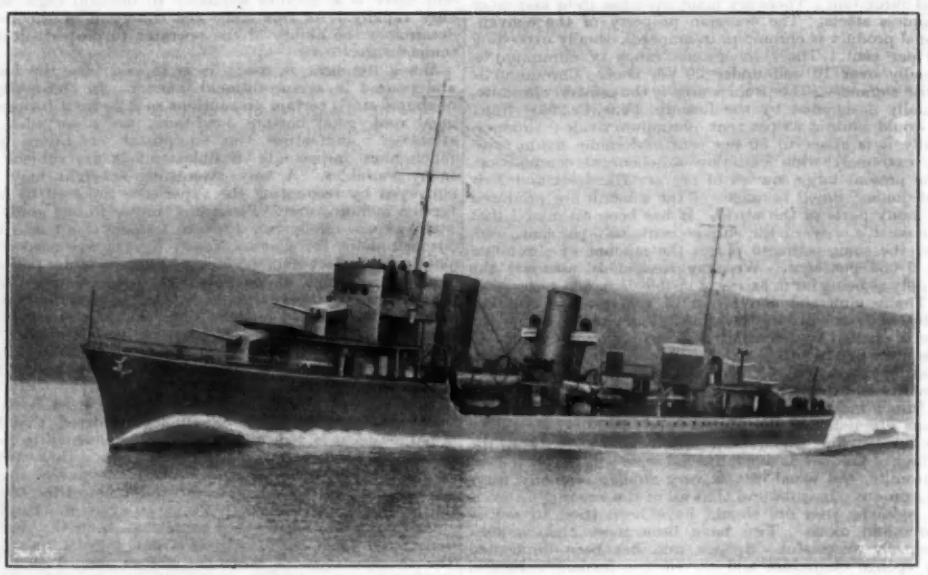
Mr. Frederick J. Marquis, Chairman of the Liverpool Organisation, also spoke on the same theme. Referring to the President's "Year of Opportunity," he said: "The whole focus of public thought is on international problems. Statesmen, as I believe never before, are burdened with problems beyond human powers; each difficulty interlocks with another; they see the trade of the world drying up, and whilst their thoughts are on these things, they are constantly harassed by the strident cries for help from industrialists at home, begging for the intervention of the State to save them from ruin, and in each country the same thing is happening. It is a profoundly disturbing picture, and whilst I am sure we everyone of us hope that they will give, to those who merit it, and give evidence of using it to the public good, but only to them, all the help that the State and the Legislature can give, we, who meet in the detachment of conference, cannot help reflecting that it was not by such means that the commercial prosperity of England was built up. We earned our position by the unaided strength of independent adventure, coming from men of commercial capacity and industrial habit. We became the great industrial centre of the world; but we began at home. The message I would like us to send out is, that we should grasp the opportunity that is nearest, that we should courageously develop the interchange of trade with our own people in our own land. It's a narrow and parochial view, but are we not in some danger of forgetting that the population of Britain, with its 44,000,000 people, presents a much greater field for enterprise than that of several of our largest Colonies all put together. And may it not be true that the damping mists of international finance with its threatened bankruptcies of nations, have dimmed even our near vision, so that we are failing to see that there are, in fact, as many people now employed in this country as there were in pre-war days of prosperity?"

Sir Francis Goodenough, President of the Incorporated Sales Managers' Association, opening the Sales Managers' Session of the Convention on Tuesday, said: "There is no country in the world of which it is more true than of ours that international trade is essential to national prosperity. If our trade with the world perishes, we perish. The large population of these little islands exists, in no small measure, through the profits of trade with other nations and on food brought from other nations. How many of us have realised that whatever threatens our ability to sell to the world sufficient goods and services, to enable us to purchase from the world our requirements of food and raw materials is as perilous a menace in times of peace as was the submarine in times of war? When is the business community of this country really going to awaken as a whole to the perils and the needs of the situation? I sometimes wonder if it will need wholesale and widespread bankruptcy to make us do so, for I still find, continuously and in all directions, evidence of the refusal of many of our traders to adjust their ideas and their methods to the conditions of 1932, which most emphatically are not those of the 'eighties or 'nineties of last century, in the atmosphere of which all too many seem still to live. I am well aware of the difficulties that beset trade with other countries to-day, but they are in no small measure due to neglect of foreign markets in the past and certainly will not be overcome by a supine or despairing or unintelligent policy. Every day that we delay in facing and fighting and overcoming the difficulties that would yield to bold and well-planned co-operative, as well as individual, effort, makes the situation more menacing and difficult. I am not a pessimist, but the only optimism that is worth anything is that which faces facts clear-eyed and takes off its coat to deal with them. I have faith enough in my fellow countrymen to believe that they will do so yet and win through—but there is not a minute to spare in this day of opportunity."

Mr. John Colville, Secretary to the Department of Overseas Trade, said: "An important feature of our commercial life to-day is a problem which has been created by the vast expansion and improvement that has occurred in our productive technique. It is within our power to-day to produce goods in quantities hitherto undreamt of, but the very prodigality of production has created for us an added difficulty, for the world has not grown larger and the consequence has been that competition between sellers in a world of few buyers has become tremendously keen. The business man cannot, of course, increase suddenly the number of his purchasers, but he can, and he ought to, ensure that every feature of his business works as efficiently and accurately as the machines in the great productive plants of which I have just spoken. In the old days markets were expanding and our commercial life was more or less settled and relatively secure. The World War and its consequence changed everything. To-day, we live in a new world, one which is highly competitive and which demands from us the last ounce of effort, and places a premium on initiative, yielding its prizes only to those who are determined to win them. This means that we must bring to our commerce that painstaking interest in individual tasks that so greatly distinguished the British craftsman in time past, but it must be the old spirit translated into new forms designed to meet the novel requirements of our age. We must revive the craftsmanship of the past in the productions of the present. To the production of first-class materials we must add the form of design suitable to the needs of a more exacting consumer world. The modern British designer is in the front rank and must take his rightful place in the *personnel* on the manufacturing side. We must no longer leave to others the honour of producing goods both artistic and original in design."

THE YUGOSLAV FLOTILLA LEADER "DUBROVNIK"

YARROW AND CO., GLASGOW, BUILDERS



SIXTY YEARS AGO.

THE letters from our provincial correspondents published in our issue of June 21st, 1872, present a remarkable picture of the state of the country's trade at that time. From the depression and panic of a few years previously manufacturing industry had, following the conclusion of the Franco-Prussian war, passed into a state of great prosperity. The iron trade was, in especial, experiencing a remarkable burst of business. One of the Barrow-in-Furness companies had eleven furnaces in blast and was producing nearly 7000 tons of pig iron per week. Even so its output was insufficient to meet the needs of its own steel works and it had been driven to make arrangements with one of its neighbours for the purchase of 40,000 tons of pig iron. In the Midlands the price of all kinds of iron had within a week been advanced by 20s. a ton. At Glasgow pig iron was quoted at 99s. 6d., or all but double the figure at which it had stood a year previously. From Scottish ports pig iron was being shipped at the rate of 21,000 tons and more a week. Although the high prices quoted for pig iron were in part dictated by the high cost of coal and other raw materials, they were also very largely determined by the great and unsatisfied demand for the products of the blast-furnace and the ironworks. New and more economical methods of manufacture had been introduced and it was estimated that pig iron manufacturers were reaping as profit at least one-fourth, and in many cases nearly one-half, of the value of their product. The chief complaint was that business was almost too easy to negotiate and that no one could say at what figure it would be safe to part with any commodity. The demand for labour could not be satified. We read of agents from the North of England invading the South Wales district with the object of offering tempting wages to workers if they would go back with them. Labour was, however, becoming restless under the joint effect of the great demand for its services and the strengthening of its unions. "Eight hours work, eight hours play, eight hours sleep, and eight shillings a day" had been advanced almost in the nature of an ultimatum by the Ayrshire and Fifeshire miners, and the coalmasters pressed with orders had in several instances conceded the demand. In the Birmingham district the puddlers had adopted an independent attitude. They were receiving wages at the rate of 10s. 6d. a ton, and if the weather was at all hot they refused to start work. They could earn sufficient by working only three days a week and they would not willingly go beyond that limit. Some, however, were taking advantage of the good times to save enough money to emigrate to America. Our South Wales correspondent reported that labourers at Dowlais formerly in receipt of 9s. to 12s. 6d. a day were receiving up to 15s. 6d. and in many cases were putting away 5s. a day for their passage money. He remarked, however, that the savings as they accumulated frequently proved an irresistible temptation to indulgence. One man whom he knew had saved up his passage money three times, but his prospect of seeing America was as remote as ever. The dissipation among the ironworkers was also alluded to by our Midlands correspondent. It had reached a stage admitted to be unprecedented by both the employers and the representatives of the workers and was exciting much apprehension.

Yugoslav Flotilla Leader.

BY the courtesy of the Yugoslav Naval Authorities, we are able to give the following brief particulars of the Flotilla Leader "Dubrovnik," which has just been completed by Yarrow and Co., Glasgow, for the Royal Yugoslav Navy. She is 371ft. 6in. long, 345ft. B.P., with a moulded breadth of 35ft., and a moulded depth of 22ft. 9in.

The bow has a raised forecastle and good flare forward, and the stern—of the special flat type developed by the builders for high speed—is of sufficient width to protect the propellers when coming alongside. High-tensile steel is used for all parts of the hull upon which longitudinal strength depends, and the whole construction is in accordance with latest naval practice. The armament consists of four 5·5in. breech-loading guns, anti-aircraft guns, and two triple 21in. torpedo tubes. Two of the 5·5in. guns surmount the raised forecastle forward and two are placed aft, and all have very wide angles of fire.

The vessel has twin screws and is propelled by geared turbines. Each set of engines consists of a high-pressure and a low-pressure turbine, whilst a cruising turbine is coupled through a clutch to each high-pressure turbine for use at low speeds. The astern turbines are incorporated in the low-pressure cylinders. The engine-room is divided into two compartments, the turbines being separated from the gear cases by a water-tight bulkhead.

The boiler plant comprises three of the latest side-fired Yarrow boilers, with superheaters and airheaters, and is arranged for oil firing. Each boiler is situated in a separate stokehold and is capable of being worked independently.

Special attention has been paid to the accommodation and living quarters, and the cabins are all high, roomy, and very well ventilated.

The vessel has just completed an exhaustive series of trials on the Clyde, when a speed of 37 knots was obtained over the six-hour trial. The fuel consumption at all speeds was remarkably low.

This vessel was officially handed to the Yugoslav Control Commission, presided over by Captain Mariashevitch, on Saturday, May 14th, and has left for Yugoslavia under the command of Captain Armin Pavitch.

OBITUARY.

COLONEL B. C. BATTYE.

WE record with great regret the death of Colonel B. C. Battye, D.S.O., R.E., Chief Engineer, Mandi Hydro-electric Project, as the result of a motor accident near Batala, on Monday, May 16th. Colonel Battye and Major Aylward, R.E., M.C., were travelling by car from Lahore on a tour of inspection of the sub-stations of the Project *en route* to Jogendernagau, the site of the power station. The two injured men were taken by a lorry to Batala, where Colonel Battye died in a few hours. Major Aylward, who was suffering from broken ribs, was conveyed from Batala to Amritsar by car and then placed in a special saloon belonging to the North-Western Railway, and conveyed to the Albert Victor Hospital at Lahore. His condition is considered serious, but does not give cause for alarm.

Colonel Battye will always be remembered in the Panjab as the man who piloted the Mandi Hydro-electric Project—see THE ENGINEER, April 22nd, 1932—destined to play a great part in the industrial development of that province. The inception originated in the report of the Conjoint

Board of Scientific Societies of Great Britain dealing with water power in the British Empire. Colonel Battye had not only to undertake the responsibility involved in the engineering side of the Mandi Project, but also the more intricate task of piloting the project through the Council of the Panjab Government, against a considerable amount of hostile criticism, and securing for the scheme the support, influence, and enthusiasm of all who could make it a success.

Colonel Basil Condon Battye passed out of the Royal Military Academy in 1900 and served in the Somaliland Campaign, 1903–04. In 1909 he was appointed Electrical Engineer, Lucknow District, and from 1910 to 1914 was in charge of the Simla Hydro-electric Scheme. During the war he served in France; he was mentioned in despatches five times, and was awarded the D.S.O., the Belgian War Cross, and the Croix de Chevalier of the French Legion of Honour. He had already received the Albert Medal for gallantry in 1906.

On his return to India after the war his services were requisitioned by the Panjab Government in connection with the Mandi Hydro-electric Project, and he was appointed Chief Engineer of the Hydro-electric Branch of the Panjab Public Works Department in 1925.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

ROAD AND RAIL.

SIR,—The letter upon this subject in your issue of the 3rd inst. will prove interesting to those concerned with the provision or the conduct of transport facilities, and it raises questions of a controversial character deserving further consideration.

The endeavour to establish a comparison of the ultimate efficiency of road and rail methods serves to draw attention to the fundamental differences which in fact justify the rational employment of both.

As your correspondent states, imperfect or incomplete consideration of these problems only leads to erroneous conclusions, and it is manifestly necessary to take into account all the cost components affecting commercial efficiency if helpful opinion is to be formed.

Mechanical efficiency as determined by power or energy consumption per unit of transport influences one of these cost components, but it is necessary to regard it as a proportional and not a preponderating influence and moreover one of varying effect with different means of transport.

There is a tendency to assume that the road vehicle, whether for passenger or goods transport, is merely a competitive alternative to the railway, whereas the service by road very often differs from or else is complementary to the railroad. For instance, metropolitan and provincial city omnibus services may partly parallel the suburban railways, but on the whole they provide much-needed transport for which no railway equivalent can be found, and admitting of no comparison therewith or of useful criticism of efficiency of the method to which there is no preferable alternative.

The same may be said of the well-known road carriers, now including the railway road services, for again there is no available alternative, horse transport having reached vanishing point except when peculiar and rare conditions favour continuation.

For this work, usually over routes or in districts not railway served, and for the completion of transport by delivery to and collection from railway terminal points, there can also be no comparison, for it is definitely outside the railway field, and in these circumstances mere mechanical efficiency assumes secondary importance.

The London Docks to Leeds example illustrates a typical railway job which can be dealt with more expeditiously and economically than by road, even though at present train making and breaking absorb time which diminishes the advantage. It is interesting to note, however, that although the comparison between low-capacity road transport units and the relatively high-capacity goods train with enforced disparity of speed of travel is manifestly unfavourable to the former, yet on a power consumption or heat unit consumption basis the road vehicle efficiency is very good and little, if at all, inferior to the steam locomotive hauled train. Relative rail and road tractive resistance and gross and net load ratios taken together tend to equalise the overall efficiency.

Your correspondent makes reference to the "present unsatisfactory state of mechanical transport," and by this phrase covers both road and rail, as doubtless he intends to do. His recommendation of co-operation or co-ordination of effort merits support, provided that the encouragement of the operators by the profits resulting from joint effective and efficient working is in turn shared by those employing the services. Too much or too little competition becomes unprofitable, and it is to be hoped that there will be no repetition of either the creation of great trading organisations without profit or the equally unsatisfactory production of unenviable monopolies.

Undoubtedly some traffic now on the roads might well be on the railways, and the latter can doubtless yield more readily unprofitable branch line or short-distance stopping traffic to the road. The more these things occur by voluntary and reasonable co-operation, and not by the enforcement of regulations, the better.

Without the embitterment engendered by compulsion the one can realise the fundamental advantages of the other and in combination, instead of in opposition, obtain relief rather than augmentation of restrictive regulation. The railway embodies the expensive essentials for fast, safe, and reliable operation, which can never be applied to the common highway so completely or effectively. It is, moreover, well to remember that the present frequency of road accident and the accompanying loss of life is to be attributed largely to irresponsible and inexperienced road travellers and only to a lesser extent to the public service vehicles or well-established goods carriers or privately owned goods vehicle operators, who do not generally emulate railway speeds and in any case are reasonably restricted by the Road Act.

Finally, whatever objection may be taken to the present disposal of the funds obtained by the taxation of motor vehicles and motor fuel, there can be little doubt that the cost of highway construction and maintenance is being borne by those who operate road vehicles, and by those who derive advantage by their use.

E. G. BEAUMONT, M.I. Mech. E., M.I.A.E.

London, S.W. 1, June 10th.

PUBLIC TECHNICAL SCHOOLS.

SIR,—In your issue of May 27th, I notice an article which is distinctly critical of the address which I delivered at the Annual Conference of the Association of Teachers in Technical Institutions. As there is some evidence in that article of a misunderstanding of the main import of my address, I should be glad to have the opportunity of offering some further elucidation.

Ideas of economy and educational ideals have been much intermingled. May I be permitted to deal with these two parts of the subject separately?

In developing educational schemes the educationalist is merely placing before the community that which he offers for sale; he may be said to display his wares. He might even go further and urge their value, but the acceptance or rejection of his schemes rests with the nation, acting through its politicians. This decision has to be taken in relation to other possible avenues of expenditure such as the Army, Navy, debt services, &c., and as it often involves questions of party politics, it is a matter which I am to a very large extent precluded from entering into, as the Association for which I happen to speak is definitely non-political. Leaving the general criticisms in the first paragraph of the article to my elementary colleagues, whom they chiefly concern and by whom I have heard them very effectively, almost crushingly, answered on previous occasions, I will pass on to the points raised directly on my address.

The first point is the suggestion that industry is to be the sole arbiter of what our children must be taught, that their education is to be appraised or condemned according to whether they fit into the great industrial machine to the satisfaction of the industrialist. This is, indeed, "misinterpreting the purpose of education." The main contention running through my address is that a liberal and cultural education under the conditions of life in this present century must be such as to enable people to understand something of the forces at work around them. By all means let there be, as there is at present in our junior technical schools, the teaching of history, geography, and literature, but the day is past when we may pretend that such subjects as these are alone educational to the exclusion of all others. If education is "to give clearness of thought," I submit that such subjects as mechanics, mathematics and electricity require at least as much clear thinking as literature, geography, and history.

Do I believe in giving education a mechanised bent? If by this is meant the adoption of standardised and mechanical methods of presenting a subject, such as are represented by the old methods of teaching Latin and Greek grammar, then my answer is in the negative. If, however, it means giving our young people an understanding of the simple scientific and mechanical processes with which they are in almost daily contact, then, frankly, yes. Surely, it is not unreasonable to ask that we should have sufficient acquaintance with the principles underlying the electrical appliances in our homes, or the motor cars upon our roads, which are in everyday use, to enable one to control them intelligently and without the undue fear and inconvenience which is born of ignorance of the mysterious.

In putting forward these views I am not forgetful of the moral and ethical side of life. In a career during which I have come into intimate contact with thousands of youths coming from all classes of schools, including public, municipal, secondary and public elementary, the conclusion to which I have come is that their moral and ethical outlook depends very little upon the type of school from which they emanate. I have had students from each of these types of high moral character, and, on the other hand, I can recall cases of criminal tendency from each type. I am of opinion that the content of a school curriculum has but little bearing upon moral attitude, and that after due allowance has been made for hereditary tendency, the main influences are the home life of the youth, the personality and character of the teacher and the social contacts which have been made. For the first the teacher has no responsibility, the second rests with the appointing authority, and is seldom lost sight of, whilst the third is being met by the social organisations within our junior and senior technical schools.

I agree that some of our technically trained youths enter the black-coat occupations and I ask: "Why not, if they prove to be suitable?"

You, Sir, seem to have the notion that most of our technical schools are engaged chiefly in training artisans, that we aim at producing fitters, turners, plumbers, joiners, &c. Such is not the case. The junior schools give a general education, based upon the principles I have stated above; the senior schools and colleges, both day and evening, provide for a specialised knowledge of the scientific and other principles underlying the processes of the various industries.

Your last paragraph implies the question: "Is it all worth while, and can it be justified?" I will let Mr. H. L. Guy make reply in an address which he gave at Merton College, Oxford, on July 20th, 1931. Speaking of the higher technical education given in our universities and technical colleges, both day and evening, he says: "Engineering in this country may die out and become an alien art. For, in every other industrial country the necessity for advanced technical education has passed beyond controversy, as did that of primary education. National comparisons of average educational level of those engaged in industry bring small comfort to lovers of this country. . . . So whatever our mood, the game is played and the issue determined for us by other nations." In fact, the whole of Mr. Guy's address is an answer from the industrial side to the question at issue.

Wigan, June 10th. S. H. MOORFIELD.

"CHELTENHAM SPA EXPRESS."

SIR,—Certain details of the working of the engine on the special runs between Swindon and Paddington on the 6th inst., which could not then be obtained in the hurry of the moment, have now kindly been supplied by Mr. C. B. Collett, and will, I feel sure, be of interest to your readers. They indicate that even at the tremendous speeds which were attained there was no question of "forcing" the engines, and they are a striking demonstration of the technical efficiency of the particular design.

The details are as follows:—

Regulator Opening, Full Throughout on Both Runs; Cut-off in Cylinders.

Up journey—	
Swindon–Shrivenham	Gradually reduced as speed increased
Shrivenham–Goring	17 per cent. of stroke
Goring–Maidenhead	18 " "
Maidenhead–Southall	17 " "
Southall–Old Oak Common	18 " "
Down journey—	
Paddington–Ealing	Gradually reduced
Ealing–Southall	23 per cent. of stroke
Southall–Slough	20 " "
Slough–Reading	19 " "
Reading–Goring	20 " "
Goring–Didcot	19 " "
Didcot–Uffington	20 " "
Uffington–Highworth Junction	21 " "

It is between Uffington and Shrivenham that the steepest adverse gradient on the down journey—1 in 660—occurs. On this, as will be observed from the full log of the run, the speed was sustained at 77·6 m.p.h., recovering to 83·7 m.p.h. on the level after Shrivenham.

There is no doubt that the more the results are examined, the more remarkable they appear.

May I take the opportunity also to correct one figure in the log of the down journey, namely, the passing time for Shrivenham, which should read 54 min. 59 sec. instead of 55 min. 03 sec.?

HUMPHREY BAKER.

June 13th.

RAILWAY SPEEDS.

SIR,—May I congratulate you upon the admirably full account contained in your last issue of the high-speed achievements of the Great Western Railway? It is most satisfactory to have so complete and authoritative a record.

Perhaps you will allow me to say a few words upon your own comments upon these performances.

You point out that railway speeds are limited by economic considerations. This is, of course, obviously true after a certain point has been reached, both in speed and in the weight hauled. No steam locomotive could haul 1000 tons at 100 m.p.h., start to stop, economically—if, indeed, at all. But I do not think you have given sufficient prominence to the very large gap which exists between the actual performances of existing steam locomotives and the work that could be got out of them without any considerable extra expense.

The extra expense involved, if any, divides itself naturally into two parts:—

(1) Expenses in connection with the road. From considerations which have nothing to do with speed, all first-class British main lines are laid with permanent way amply strong enough to withstand the greatest stresses now put upon it. This is done because maintenance costs, both of road and rolling stock, are thereby greatly reduced. In point of fact, speed has little or no effect upon costs of maintenance. I have on different occasions asked the chief engineers of two important British lines whether on steep gradients, where the speed of descending trains is much higher than the speed of ascending trains, there was any difference in the costs of maintenance of the up and the down lines. Both replied that there was no difference. When it is also remembered that it is much easier to make accelerations by increasing speeds uphill rather than by increasing maximum speeds, I think that it may be safely assumed that the extra expense connected with the road will be very small.

(2) Expenses in connection with the train. These are almost confined to locomotive expenses. Although the ordinary steam locomotive has certainly not yet reached her highest possible development, I will merely point out a few facts regarding the work done by existing machines, based upon the latest available table of train resistances, that deduced from the recent experiments of the Paris–Orleans Railway and published on page 60 of the *Revue Générale des Chemins de Fer* for July, 1931.

Unfortunately, this table does not give resistances for

speeds over 75 m.p.h., so it is not possible directly to work out the approximate horse-power developed by the G.W.R. "Castle" which worked the record-breaking train from Swindon to Paddington. But, by making what appear to me to be reasonable increases, proportional to the speed, the result works out at 21 horse-power per ton weight of engine maintained for about three-quarters of an hour.

On the Nord I have over and over again found the engines capable of developing 26 horse-power per ton, calculated from the table, up all the long inclines that are found on the main lines of that railway. It is not usually possible to maintain this effort for more than ten or twelve minutes, because the ascents are not long enough, but full steam pressure is almost always maintained throughout.

The records left by Mr. Charles Rous-Marten enable the horse-power to be calculated which was developed by 4-4-0 engines of the "721" class of the Caledonian Railway on various ascents of Beattock Bank in 1896. This works out at fully 20 horse-power per ton of engine maintained for a quarter of an hour.

On the other hand, most of our fastest expresses of the present day can be worked with an average effort of 12 or even 10 horse-power per ton weight of engine, calculated from the same table.

I understand that the coal consumption of the G.W.R. engines when working hard is quite moderate, and the same is certainly the case on the Nord.

This leaves the extra wear and tear of boiler the only considerable source of expense that need be anticipated from big accelerations. If this amounts to £200 per annum, the cost per mile is 1d., or thereabouts.

MONKSWELL.

London, S.W. 7, June 12.

"ORDERS FOR MILLIONS GOING ABROAD."

SIR,—Your correspondent, Mr. T. S. Catmur, asks "What stops us getting these orders?" Having had some experience overseas in dealing with the purchase of machinery from British manufacturers, I can give several reasons why trade goes to other countries.

In the first place, insufficient information is given about the material quoted for, and the prospective purchaser has usually considerable difficulty in getting such information. It is a great advantage to be represented overseas by an engineer who has a detailed knowledge of the articles manufactured, and in certain cases of the manufacturing processes.

British firms are gaining a reputation for unreliability in regard to delivery dates. This often causes so much inconvenience that the customer is most unlikely to repeat his order.

Finally, there is often sent abroad material of very poor quality. There is an impression that anything not quite up to standard is considered good enough for export.

However, British machinery is still regarded as the best in the world, and a little more appreciation of the customer's point of view would undoubtedly help the sales.

J. K. MACLEOD, M.I. Mech. E.

London, W. 2, June 13th.

FURNACE DESIGN.

SIR,—My attention has been drawn to an article by Mr. H. C. Armstrong, which appeared in your issue of the 3rd inst. under the title of "The Effect of Furnace Design on Scale Formation."

Whilst informed criticism is always welcome, the article contains rather sweeping statements, not calculated to increase confidence in that long-suffering fraternity, the professional furnace designers, and as a member I would like to be permitted to say a few words in defence.

Mr. Armstrong is to be congratulated on the able way he states his case for the short flame, and he rightly stresses the importance of intimately mixing air with fuel prior to combustion, wherever possible. This is, of course, an elementary principle in combustion engineering, which, far from being not appreciated, has been well known and understood by the professional furnace designer for many years.

The short flame, however, is not always desirable, and cannot be applied to all furnaces, and Mr. Armstrong's remarks are likely to be misleading to the uninformed.

With small high-temperature furnaces for forging purposes, where a rich fuel is used, intimate mixing of air and fuel is essential, and I assume it is this type Mr. Armstrong has chiefly in mind.

It is rarely possible for the professional furnace designer to design a furnace as he would wish. Considerations of first cost, class of fuel available, restrictions of site, &c., invariably force him to a compromise in design. Often the buyer has prejudices which limit the scope of the designer. Indeed, the buyer will sometimes take a hand in design, and after cutting down the price to a bare minimum will call for stringent guarantees regarding performance and fuel consumption. In some cases the professional designer is not consulted at all, and many furnaces are converted and altered to suit the ideas of their owners or users. I have heard of cases where old furnaces, originally designed for direct firing, have been converted to town's gas firing by the owners by the introduction of a few gas pipes with some holes in the furnace walls for air inlets.

The three designs illustrating the article bring out very clearly Mr. Armstrong's points, but I was disappointed that modern arrangements of ports and methods of mixing were not shown.

Mr. Armstrong mentions that German furnace engineers have recently developed the short-flame burner in which high-pressure coke oven gas induces the required air. British engineers developed such a burner years ago when high-pressure town's gas was first introduced into this country for lighting and heating. These burners will give very short flames with gas pressures of 2 lb. to 5 lb. per square inch, whereas coke oven gas in Germany is supplied at pressures of the order of 10 lb. per square inch and more. With so high a gas pressure it is not a difficult matter to obtain rapid and efficient mixing of gas and air. The real test of a short-flame burner is one calling for the shortest flame with nearly correct gas and air ratio, with minimum gas and air pressures in a minimum mixing space, quantities of fuel being equal, of course.

A. OGILVY-WEBB.

London, S.W. 1, June 15th.

THE FALL OF THE TAY BRIDGE.

SIR,—"Sixty Years Ago" in your issue of June 3rd brought back to me the hypothesis I formed at the time, and have seen no reason to revise.

It may be recalled that a great gale was blowing, and that a train had advanced on to the bridge when it collapsed. My notion is as follows:—The broadside-on gale had made the bridge swing laterally at something like its natural period, considered as an inverted pendulum. The advent of the train altered the period, and at the same time increased the wind pressure by its side area. These two happenings, the interference with the swing probably the largest factor, put a stress on the C.I. columns, of which the piers were built, which they could not bear; probably they broke where the old and the new swinging movements met in opposition. If I remember rightly, the columns had flanged joints; if so, probably they failed.

I read the reports of the inquiry, and found nothing there in conflict with my theory. I do not think anyone suggested it in evidence nor in the report.

There was evidence of faulty maintenance, perhaps of faulty execution of the original work. I have good reason to remember the disaster, for I was then working in the Central Telegraph Office in the Scottish Division, and the flood of work was phenomenal; all the more, that we had no wires working north of Edinburgh—they had all gone to the bottom of the Tay.

HENRY M. SAVERS.

London, S.W. 16, June 13th.

ATMOSPHERIC RAILWAYS.

SIR,—There is one point in Mr. Newson's extremely interesting letter which I must set right. Brunel was only connected with the South Devon Railway.

I feel a little disappointed that, while the historical part of my letter has attracted so much interest, the question of the feasibility of atmospheric locomotion in a tunnel, to which I wished to draw attention, has not aroused any comment.

C. F. DENDY MARSHALL.

Guildford, June 13th.

SURVIVAL OF THE CONSULTING ENGINEER.

SIR,—May I be allowed to add my humble opinion, and attempt to reply to the three interesting questions raised by Mr. J. G. H. Warren in THE ENGINEER, June 3rd?

First, whatever branch of engineering a man claims to understand, he cannot have gained much experience until he has reached thirty-five years of age. Apart from technical qualifications, he should have had long practical experience in the particular business in which he specialises.

Secondly, to share responsibility for the ultimate success of work undertaken, and not to expect remuneration until the client is satisfied.

Thirdly, a client frequently does not know exactly what he requires for his particular purpose. An engineer well versed in the client's line of business should investigate conditions and requirements, advise what to buy, and where to buy it. The client is unwise if he allows himself to be guided by the manufacturer only. When the source of supply or manufacture has been decided upon, the consulting engineer and the supplier should jointly share the responsibility. Without the services of a consulting engineer, it is possible for a manufacturer to say, "Well, I have delivered the goods as required; if they are not just what you require, it's no fault of mine!" It may well be said, "Why employ a solicitor?" Oh! for the Golden Rule in business.

June 13th. E. M. H. S.

SIR,—Referring to the subject of the leader in your issue of May 13th, on the "Survival of the Consulting Engineer," I have recently noticed an advertisement in the "Situations Wanted" column of a well-known technical paper, in which the advertiser refers to himself as a "Consulting Engineer," in spite of the fact that he gives his age as being well under thirty years.

Doubtless this is, in many respects, the age of the "young man," so far as opportunity for advancement is concerned; but if there is one profession above another which calls for the experience of men well past middle age I suppose it is the calling of the consulting engineer, in whose work one ounce of practice is worth at least one pound of theory. The "theory," in this instance, being taken to mean the indiscriminate use of book knowledge as is sometimes indulged in by those who have only left their technical school, or university, a few years previously.

In spite of the increasing employment of fully qualified and competent engineers on the staffs of many contracting firms, there will always be a sphere of usefulness for the consulting engineer, so long as purchasers are without the technical knowledge necessary to enable them to know whether, or not, they are being treated fairly.

Naturally, if every "Tom, Dick and Harry" in the profession is allowed to term himself a member of that branch that has always had the "Blue Riband" associated with its name, the public will soon find themselves unable to distinguish between the genuine article and the pretentious upstart, to their probable financial loss and the eventual disappearance of an honourable profession.

P. C. RUTHVEN, A.M. Inst. C.E.

Eastbourne, June 15th.

SIR JAMES JEANS AND THE UNIVERSE.

SIR,—I respectfully suggest: That if the radius of a circle becomes infinite, what results is an infinitely large circle whose complete curve does not become an infinite or any other straight line.

Likewise, that a sphere of infinite radius has an infinitely large surface that remains spherical and cannot be a boundless flat plane at all.

If this is right, then Euclid would seem to be still useful.

WM. JNO. TENNANT.

Henley-on-Thames, June 13th.

PROBLEMS OF SHIP PROPULSION.

SIR,—In the interesting article by Mr. G. S. Baker under the above title, which appeared in your issue of May 27th, the author states that "in our usual haphazard way, Great Britain's representation was left to the chance choice of a number of technical institutions scattered over the country." He then gives a list of those present from Great Britain, but, presumably inadvertently, omits the British member, Mr. W. Lumsdon, who attended the Conference as an official representative of this Institute. Mr. Lumsdon's name appeared in the list of representatives which you published in the preceding week's issue, but it is perhaps desirable that readers of Mr. Baker's article should be acquainted with the omission to which this letter draws attention.

In connection with the question which Mr. Baker raises as to the value of such international conferences, it may be of interest to add the opinion of some of the visitors, as reported by our representatives, that the Conference, although very well prepared, suffered somewhat from the abundance of the papers and contributions, all on a rather high scientific plane. They consider that it exceeds by far the capacity of even a specialist to receive and assimilate during the Conference this great amount of scientific matter, and they consider that the real value of the Conference will be determined later on when all these papers and discussions have been printed and circulated.

B. C. CURLING,
Secretary, The Institute of Marine Engineers.

London, E.C. 3, June 14th.

INTERNATIONAL CONGRESS OF ELECTRICITY

THE Congress which has been arranged to celebrate the fiftieth anniversary of the first International Congress of Electricity will be opened by the President of the French Republic in Paris on July 5th at 10 o'clock, and will be concluded on July 12th, when trips to places of interest in France will be started. The Congress will be conducted under the following sections and sub-sections:—

1*st Section.*—Electrical and Magnetic science. General theories. Insulators. Conductors. Radio-activity. Magnetic bodies. Thirty-five papers.

2*nd Section.*—Electrical measurements:

1st Sub-section: Units and standards; absolute electrical measures. Twelve papers.

2nd Sub-section: Laboratory measurements; industrial measurements and experiments with machines. Nineteen papers.

3*rd Section.*—Production and transformation of electrical energy. Thirty-four papers.

4*th Section.*—Transmission and distribution of electrical energy. Seventeen papers.

5*th Section.*—Electrical Traction. Mechanical applications. Seventeen papers.

6*th Section.*—Electric lighting. Photometry. Eight papers.

7*th Section.*—Electro-chemistry. Electro-metallurgy. Batteries and Accumulators. Twenty-one papers.

8*th Section.*—Telecommunications by wire (distant communications by wire). Nine papers.

9*th Section.*—High-frequency current phenomena.

1st Sub-section: Radio-electricity. Ten papers.

2nd Sub-section: Radio-communications. Six papers.

10*th Section.*—Radio-biology. Electro-biology.

1st Sub-section: Radio-biology. Five papers.

2nd Sub-section: Electro-biology. Three papers

11*th Section.*—Atmospheric electricity. Terrestrial magnetism. Nine papers.

12*th Section.*—Various applications of electricity. Eighteen papers.

13*th Section.*—Teaching and History of electricity. Two papers.

The offices of the Congress are at 134, Boulevard Haussman, Paris.

THE Metallographic Institute in Stockholm is being reorganised on broader lines so as to establish a more intimate co-operation, both with the industry and with scientific research work in general.

Railway and Road Matters.

OUR last two Annual Railway Engineering Articles have made reference to two conversions from double track to four lines of way on the Manchester and Buxton branch of the former L. and N.W.R. One, ¾ mile long, was at Hazel Grove, and the other, ½ mile long, at Dove Holes. Both works are now completed and opened for traffic.

THE London, Midland and Scottish Company, in order to increase the electrically operated train services between Euston and Watford and between Broad-street and Watford, is installing automatic signals of the colour light type between Camden and Watford on the up and down lines reserved for those trains. The section between Willesden and Hatch End was brought into use on Monday, June 13th.

IT is officially announced that largely as the result of the experiment in traffic control by lights along Oxford-street, the whole of the Metropolitan area is to be gradually dealt with in a similar manner. The Ministry of Transport, which contributes 60 per cent. of the cost of installing mechanical appliances for the purpose, recently called a conference of the authorities concerned in order to avoid confusion and possible overlapping, and the work of erecting the required plant is in many cases to proceed at once.

WE would, with great pleasure, join our railway contemporaries in congratulating Lord Ashfield on the completion of twenty-five years' connection with the London Underground Companies. As Mr. Albert H. Stanley, who was born in Derby and went to America as a child, he was brought by certain American interests, who had financed the electrification of the Metropolitan District Railway and the construction of some of the tube railways, to London in 1907 to be the general manager of those lines, and when Sir George Gibb went to the Road Board in 1910 he succeeded that gentleman as managing director.

AN institution on the former Midland Railway, which must now be at least sixty years old, is the sack and sheet stores at Trent Junction. The sacks are hired to millers, maltsters, farmers, and others for the conveyance of grain, and millions of sacks are dealt with annually. After use by traders the sacks, under a hire penalty, are returned to Trent where they are shaken and turned. Hitherto, this has been done by hand, but the turning is now performed mechanically and the emptying and cleaning by a special vacuum system. The London, Midland and Scottish Company, whose property the stores are now, has about 738,000 sacks, and can deal with the cleaning of 2000 a day.

IN the matter of safety the Underground Railways of London have a remarkable record, owing mainly to the use of the automatic signal system and the automatic train stop. Until Friday last, June 10th, only three collisions—none with fatal results—had been inquired into by the Railway Department during the last twenty years. The three previous accidents were:—Caledonian-road, September 4th, 1912; Warwick-avenue, February 25th, 1918; Charing Cross, January 19th, 1925. What happened on Friday last was a gliding collision between two westbound Piccadilly tube trains at Hammersmith, in which, from some cause not at present clear, one train collided with another as the latter was leaving a siding and passing on to the line on which the other train was approaching. There were no personal injuries.

THE Ministry of Transport Railway Statistics for the four weeks ended March 26th last have recently been issued as a Stationery Office publication, price, post free, 2s. 7½d. In their consideration, it must be remembered that the period in question covered Easter, which festival fell in April last year. Compared with the corresponding period of 1931 there was an increase of 0·9 per cent. in the number of passenger journeys and of 10·7 per cent. in the receipts from passengers. Despite this increase, there was a fall of 2·2 per cent. in the passenger train mileage. In freight traffic there was a decrease of 7·8 per cent. in the tonnage, of 9·9 per cent. in the receipts, and of 7·6 per cent. in the freight train mileage. The average train load increased, however, from 126½ to 127½ tons, and the net ton-miles per engine hour—*i.e.*, speed of movement—from 447 to 462.

THE Bricklayers' Arms branch was built in 1843–44 by the London and Croydon and the South-Eastern Railways jointly, because of the alleged excessive toll charged by the London and Greenwich Railway for the use of London Bridge Station and the approaches thereto. Under the empowering Act, the line passed into the hands of the South-Eastern entirely, and it and Bricklayers' Arms Station were opened on May 1st, 1844. At some period later it ceased to be used as a passenger station, but photographs of the early 'sixties show it as still so employed, and it was at that station that Princess Alexandra of Denmark—the late Queen Alexandra—arrived on the eve of her wedding in March, 1863. The station is now once more being used for passenger purposes, as excursion trains on Sundays commenced to start from and arrive back there on June 12th.

A NEW European rail speed record will, it is claimed, be established by the L.M.S. Railway on July 18th, when as part of a sweeping programme of train accelerations, "The Mancunian" express will be re-timed to cover the 177 miles from Wilmslow, near Manchester, to London (Euston) in 172 minutes, at an average speed of 61·7 m.p.h. This is claimed to be the longest non-stop railway journey in Europe to be scheduled at over 60 m.p.h. "The Mancunian" will leave Manchester (London-road) at the present time of 9.45 a.m., but will be due at Euston at 1 p.m. instead of 1.15 p.m. This new record run forms part of a comprehensive speed-up to be effected with the introduction of the summer time-table on July 18th, whereby 2026 L.M.S. trains will be accelerated by a total amount of 6424 minutes daily. Under the new schedules no fewer than fifty-four L.M.S. expresses will make regular start-to-stop journeys at average speeds of 55 m.p.h. and over for journeys of not less than 60 minutes' duration. In addition to the further accelerations of the Anglo-Scottish services, the L.M.S. will speed up business and holiday trains all over their system.

Notes and Memoranda.

THE report of the provincial Bureau of Mines gives copper production in Quebec during the first quarter of 1932 as 15,758,511 lb., against production in the whole of last year of 69,225,430 lb.

ELECTRIC and railway company plants in Japan have a capacity of 3,188,452 kW, individual industrial plants 1,005,171 kW, making the total of all kinds of electrical installations 4,193,623 kW. Public utility plants number 774, those of individual industrial companies 5542.

ACCORDING to Major W. Gregson, the following is a typical open-hearth furnace heat balance:—(*a*) Heat loss in producers and transmission, 20; (*b*) heat used in furnace bath, including sensible heat in products, 10; (*c*) radiation and cooling water losses, 30; (*d*) chimney loss, 40 per cent.

IMPORTS of electrical machinery and apparatus into Italy during January and February last amounted to £363,850, as compared with £598,390 during the corresponding period of last year. On the other hand, exports of similar material during the same period increased from £189,820 to £250,535. The Italian lire has been converted at 73 to the £.

THE number of deaths due to accidents among the crews of vessels registered in Great Britain and Northern Ireland under the Merchant Shipping Act, 1894, that were reported during the month of April, 1932, was twenty-four, of which eight were caused by casualties to vessels. Four of these deaths from accidents were reported on sailing vessels.

GREAT BEAR LAKE, in the North-West Territories, states the *Canadian Engineer*, is the largest lake contained within Canadian boundaries and is the fourth largest on the American continent, having an area of 11,663 square miles. The lake has become prominent recently on account of the rich finds of silver, radium, and copper ores, and several companies have already staked claims along the shore of the lake.

IN a paper read before the Royal Society of Arts recently, Mr. J. F. Hennessy, A.R.A.I.A., said the Australian Building Acts allowed a height of from 132ft. to 150ft., and in some cases water towers, lift towers, or ornamental features might go up to 200ft. or more, but most Australian civic authorities exercised a great deal of supervision over architects, who had to supply them with all calculations for structural work, such as concrete, steel, beams, and columns, together with full details of weights and foundation designs. This, he said, involved an additional overhead expense of about 30 per cent. to the architect. Increasing land values, often up to £3000 per foot frontage, made economical planning difficult, for most clients required a return of at least 7 per cent. on the cost of the building.

ATTENTION to corrosion-resistant properties in metal parts has brought new machining problems into the workshop. Some of the more recent non-ferrous alloys, says Mr. J. R. Godfrey, in the *American Machinist*, range in hardness and toughness above ordinary steels, and need methods in machining differing from those used for even the hard bronzes. Illium, which has lately been employed extensively for cast pump parts, chemical processing and mining machinery parts, has a fairly high percentage of chromium and nickel together with tungsten and molybdenum. It can be turned readily at speeds to 30 surface feet per minute with a 0·032in. feed if super high-speed tools are used. The tool for turning is ground with a flat lip, 6 deg. to 8 deg. positive rake, and about 5 deg. nose clearance.

FOR determining the durability of bridge paints, the engineering department of the Nashville, Chattanooga and St. Louis Railway is using a simple test method. A steel saucer about 5¼in. in diameter and ¾in. deep, made from 22 or 24-gauge sheet metal, is given a priming coat of red lead and linseed oil, inside and out. Half of it is then painted with the railway's standard finishing coat, and the other half with the paint to be tested. Considerable care is exercised not to break any of the paint on the edges. The saucer is then placed, with others under test, in a wooden rack. Cinders from the stack of a locomotive are placed in the saucer, and water is added. The water level is maintained by frequent inspection, and observations of the condition of the paint are made every six months. For identification a numbered copper tag is attached to each saucer.

WRITING to the editor of the *American Machinist*, Mr. P. N. Nielsen, of Wallasey, describes a method he adopted to straighten a short stiff shaft. An armature shaft was badly bent, the bent part being short in proportion to its diameter. He says that "as it was not possible to use heat and the screw jack was not effective, we resorted to what I think was an unusual procedure. It occurred to me that when a shaft is welded it is distorted with the high side opposite the weld. We therefore got the electric welder to strike an arc on the high side of the bend, depositing a small bead of metal about ¼in. diameter. The result was surprising, the shaft being perfectly true. The fact that the shaft was true first time was probably due to luck, but there is some possibility of useful results with practice. The bead can be removed from the shaft without disturbing the trueness of the shaft."

AN article in the *Engineering News-Record* describes the measures adopted in California to prevent drifting sand from interfering with road traffic. Three conditions are encountered:—(1) Sand dunes of considerable height, where the movement is comparatively slow, usually in desert areas where lack of moisture precludes planting to secure stability. Here, if possible, a trench is cut in the dune in the direction of the prevailing wind, which facilitates the movement of the dune over and across the highway. (2) Long flat stretches of a broad expanse of sand swept by wind. This also is a desert condition and is handled by the installation of snow fences set back from the highway. (3) Beach dunes continuously replenished by the ocean. Here planting is attempted to retard progress of the sand, and every effort is made to eliminate abrupt breaks in the slopes of the roadway, which might check the velocity of the wind and so prevent it from sweeping the sand across the highway.

Miscellanea.

OIL is reported to have been discovered on Bahrein Island, in the Persian Gulf.

THE amount of nickel used per ton of alloy steel produced in the United States increased about 25 per cent. in 1931 as compared with 1930.

THE Municipality of Mysore has decided to make provision for a supply of 4,000,000 gallons instead of the present supply of 2,500,000 gallons per day. The Chief Engineer's estimate for Rs. 3,00,000 to install new pumps, increasing the capacity of the reservoirs and for improving the water supply has been approved.

THE Association Technique de Fonderie has been authorised by the Comité International des Association Technique de Fonderie to organise the World Foundry Congress of 1932. It will be held in Paris between September 13th and 18th next. An International Foundry Exhibition will be held at the same time.

A NEW manual telephone exchange at Pinner in Marsh-road, the equipment of which was manufactured and installed by Standard Telephones and Cables, Ltd., was brought into operation by the General Post Office on June 8th. The equipment is for 3340 lines and extensions to provide ultimately for 9500 subscribers are contemplated.

IN order to combat droughts in the Volga region of Russia, the Soviet Government has decided to build a hydro-electric power station on the Volga to irrigate over 4 million hectares of arable land in the Middle Volga district, from Kinel to Samarka in the North, and the Lower Volga district, on a parallel line to Kamishin in the South. The power capacity of the new station is to be 1·8 to 2 million kW, and the plant is expected to be complete by 1937.

BETWEEN May 1st and 31st, the record number of 3372 travellers flew between London and Paris in the air liners of Imperial Airways. The previous greatest monthly figure for passenger traffic on this route was 3304, set up in the height of the holiday period in August, 1928. A feature of the traffic for May was the influx of holiday-makers from the Continent to London. Many more people flew from Paris during the month than in the reverse direction, although, as a rule, the heaviest traffic is outward from London to Paris.

THE monthly report of the National Federation of Iron and Steel Manufacturers shows that there were sixty-nine furnaces in blast at the end of May, the same number as at the beginning of the month, three furnaces having ceased operations and three having gone into blast. The production of pig iron in May amounted to 315,300 tons, compared with 316,900 tons in April, and 346,500 tons in May, 1931. Production includes 75,400 tons of hematite, 128,000 tons of basic, 92,600 tons of foundry, and 11,300 tons of forge pig iron. The output of steel ingots and castings in May amounted to 416,900 tons, compared with 433,300 tons in April and 435,100 tons in May, 1931.

THE extent to which the Canadian mining industry is dependent upon electricity, and particularly upon hydro-electric power development, is illustrated in an article in the *Electrical News and Engineering* (Toronto) of April 15th, where it is shown that in 1930 mining industries in the Dominion utilised 2,573,870,513 kWh, of which 1,752,490,909 kWh represented purchased power utilised in metal mining. Metal mines generated for their own use another 309,258,106 kWh. Canadian collieries also used electrical power, the total in 1930 being 74,054,109 kWh of purchased energy in addition to 94,972,298 kWh generated for use at the mine.

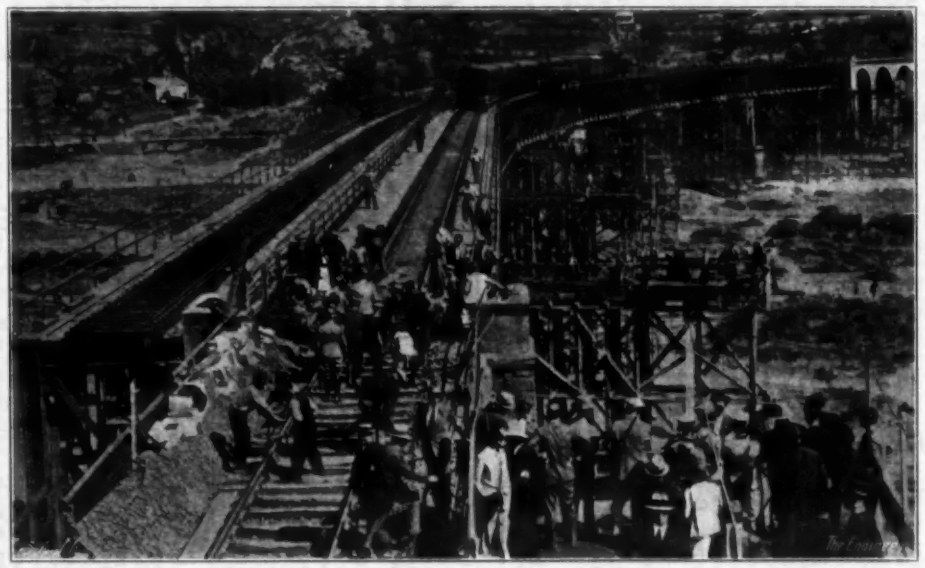
THE new open-hearth plant of the Illinois Steel Company, at its South Works, Chicago, consists of fourteen 150-ton stationary furnaces, with provision for the installation of an additional furnace. The capacity of the fourteen units is, says the *Iron and Coal Trades Review*, estimated at 1,600,000 tons of ingots per annum, or sufficient for the needs of the wide-flange beam mill and the new slabbing and plate mills at the South Works. The charging side is served by two travelling cranes of 65ft. span, each having 150-ton main hoist and 40-ton auxiliary. Hot metal is supplied in 100-ton ladles. Fourteen 640 H.P. waste-heat boilers of the horizontal fire-tube type, each having 7960 square feet of heating surface and 460 square feet of superheaters, generate steam at 275 lb. per square inch.

A NEW regular monthly feature commences in the current number of the *Journal of Scientific Instruments*. For some time past it has been felt by the Journal Advisory Committee that the specialised articles on definite forms of instruments which have hitherto been the principal feature of this journal might well be supplemented by articles of a wider scope dealing with the trend of development of various classes of instruments or with matters of general interest to instrument manufacturers and users. It is believed that the contribution of these articles by recognised authorities of long and wide experience will prove of great interest and service by giving critical surveys of present practice, and by indicating the lines upon which future progress may be expected. The *Journal* is produced by the Institute of Physics with the co-operation of the National Physical Laboratory.

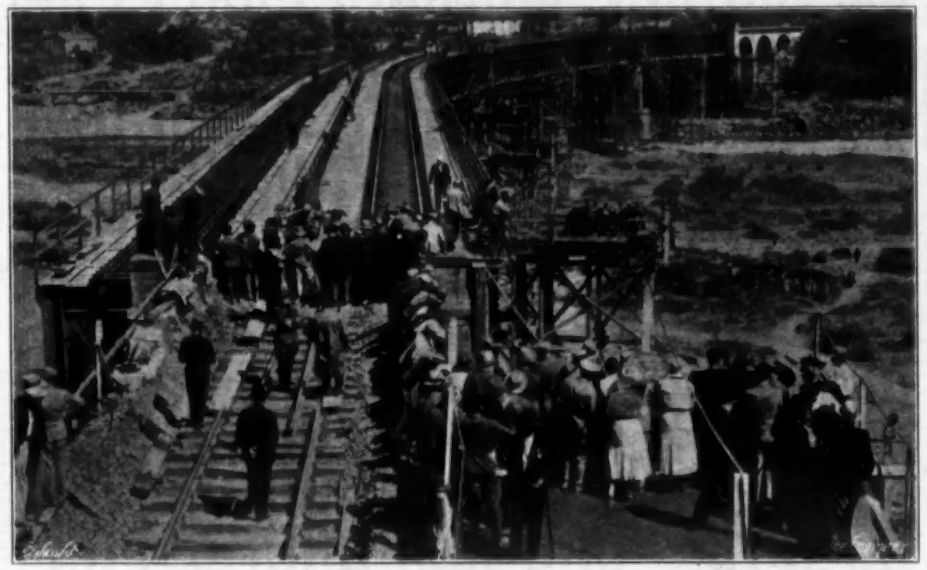
IT was stated in Parliament recently by Mr. A. C. Walsh, managing director of Pearson and Dorman, Long, Ltd., and chairman of the Kent Coal Owners' Association, that Dover was the only possible port from which to develop an export trade of any importance. There was a shorter land haul than to other ports and larger ships could use the port. They had shipped coal to Belgium and France and sent one cargo to Greece, but the principal export at present was to Holland where the coal was used in steel works at Sluiskil. That, he believed, was taking the place of German coal. Their coal was good coking coal, and he thought that in that respect it was so superior to Continental coal that there would be a large market for it; but they must be able to ship it at a reasonable cost. Coal could be put into ship at Dover 4d. a ton cheaper than at Queenborough, and there was a further saving of from 3d. to 6d. a ton arising from the possibility of using larger ships at Dover.

REPLACEMENT OF A RAILWAY BRIDGE OVER THE TARO, ITALY

(*For description see page 671*)

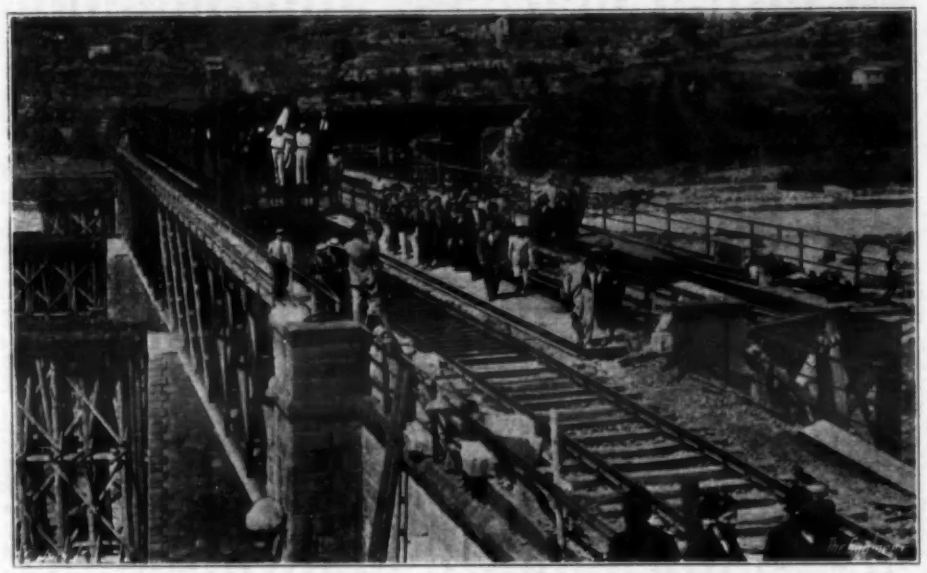


PASSAGE OF LAST TRAIN OVER OLD BRIDGE



TRANSFER OPERATION IN PROGRESS

TRANSFER OPERATION COMPLETED



PASSAGE OF FIRST TRAIN OVER NEW BRIDGE

The Engineer

JUNE 17, 1932.

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STAINLESS STEEL AND ITS FUTURE.

AT the May Meetings of the American Iron and Steel Institute Mr. E. C. Smith read a paper entitled "Stainless Production—Equipment and Method of Manufacture." Mr. Smith is Assistant District Manager, Central Alloy District, Republic Steel Corporation, Massillon, Ohio, U.S.A. Whilst we do not pretend to understand the significance of the titles conferred upon Mr. Smith by the organisation which he serves, we recognise that he is a master of the subject covered by his paper. We cannot recall any other which deals so fully with the numerous aspects of stainless iron and steel manufacture, and it is with much pleasure that we reprint much of it in our pages, confident that, whilst it cannot fail to attract the attention of all who are engaged upon the production of "stainless," it will excite the interest of the far larger number who are users of such materials or who are watching with hopefulness their economic future. From the limited scope of Brearley's original discovery, the production of high chromium steels and irons has developed into an important industry with still unknown possibilities and unforeseen uses. We cannot suppose that the makers of stainless cutlery ever anticipated that stainless sheets would be employed for architectural embellishments, or that the material, but slightly modified, would solve the problems which high temperatures and high stresses force upon the attention of mechanical engineers. That "stainless" materials have not yet taken their place in structural engineering for which their qualities peculiarly fit them, is mainly due to their high price, but with the examples of several other metals—notably aluminium—being reduced as improved methods of manufacture were devised and the demand very greatly increased, it is not wholly unreasonable to hope that high chromium steel bridges may some day span the rivers of the world and solve at once—by removing them—the problems of corrosion and the enormous annual expenditure which the decay of ferrous materials causes.

In the opening sentence of his paper—not reprinted—Mr. Smith refers to the economic results associated with "stainless," and no excuse is necessary for following him into that aspect of his subject. He refers to the new relations which are established by the arrival of a new product and the industrial disturbances which they bring about. "Any discussion," he writes, "of a product which is in progress of establishment must be coloured with much of this disturbance. It is difficult to compare the advantages now known for the new product with the disadvantages caused in adapting present equipment to new processes; the competitive materials now being produced; and the probable competitive materials that will develop once the idea of the new material is widely spread." It is easy to understand all that is implied in that sentence—the heartburnings over the rejection of existing plant; the opposition of those who hate change; the need to train men in new methods; the disturbance of organisations, and so on—yet we may hope that as Great Britain was the birthplace of stainless steel, and has already a considerable industry in it, it will be the first to press forward with new developments. It is often said that the greatest asset of British engineering is the excellence of its products. Here is a case by which that can be proved, for Mr. Smith makes it clearer than ever that in the production of stainless steel a new and higher standard of steel works procedure is an absolute essential. It is, we gather from him, the modifications in the methods and practice of steel works to meet the exacting requirements of the new material that are likely to maintain its cost rather than the price of chromium itself, for the supply of chromium in the earth's surface is far in excess of visible demand; and in the course of time its price should fall as the demand increases. The usual precautions which are sufficient for the making of simple steels will not do for the production of "stainless"; even such an event as a slight leakage of air into the furnace may ruin the heat, whilst "all grades are extremely sensitive to moisture, either in the materials or about the furnace." The form and size of the ingot present another problem which is only being solved by trial and error, for the weight of ingot which may be used, for chrome-nickel stainless iron, or for straight chromium iron, is much too great for, say, the heat-resisting alloys. "The most important stage," writes Mr. Smith, "in the making of any stainless heat is the selection of ingot section and the handling from the casting through to the first stages of working. Again, with the exception of the chrome-nickel stainless irons, which appear to be complacent and adaptable, cracking during cooling and reheating is so much to be feared that "the risk involved is too great to encourage large ingot production aside from those to be rolled as soon as possible after casting." Furthermore, reheating of stainless steels for re-rolling is a slow business, for "they are remarkably low in their rate of heat conductivity," and they have very narrow temperature ranges in which they must be soaked. Then, owing to small surface defects, a great deal of the ingot has to be removed before rolling can be safely undertaken. Mr. Smith mentions that in Europe the practice is to machine off about $\frac{1}{4}$in. from the surface of ingots no more than 16in. across; but in America the billets are ground, chipped, or milled. Grinding must be done with extreme care, so that no fine shavings remain. Finally, to use Mr. Smith's words, "the rolling of stainless steel into bars is a process more fitted to the flexibility of the tool steel mill lay-out than the big production continuous mill. . . . The risk involved in attempting to produce under conditions encountered in simple rolling is too great."

We have said enough to show that the production of stainless steel calls for exceptional procedure, and that on that account the price must be high. How far it is likely to be reduced by further developments is an extremely interesting problem. Mr. Smith himself does not appear to be very hopeful, and it will be observed that in his conclusion he does not refer to its uses in structural engineering or shipbuilding. He holds that it would be unwise "to predict many thousands of tons of this material annually for some period of time." The production problems are still serious, and at present only the tool steel mills can handle them. Yet he does foresee that after years of development and experience mills with organisations of men "trained to understand the production of this metal, which comes more closely to the ideal commercial metal than any so far developed," will be set up. We do not hesitate to unite ourselves with him in his confidence in the future. A great opportunity is thereby offered to British steel makers who have always excelled and led the world in the production of the highest classes of steel. There is, too, an opportunity for clear-cut organisation which might with advantage receive the attention of the new National Committee. There is some danger that many works may take up the manufacture of stainless materials. The indications are that concentration in a few would lead to more rapid progress; no more need be said.

Production for the Masses.

SEVERAL years ago an American novelist, Mr. Garet Garrett, prophesied in a tiny volume the mastery which machines would gain over man. That little book, "Ouroboros," is well known to engineers, and the truth of the picture it presents is admitted by most of them. To-day many more people are thinking as Mr. Garrett thought in 1926. The greediness of the machine has been forced upon them. At one time they saw only the astonishing result of mass production methods as reflected in the increase of output and reduction of costs. The world was ready to consume all that the mass production factories could provide. Output rose, as in Mr. Ford's factory, to fabulous figures, and yet the demand was not exhausted. The principle spread; other manufacturers in a variety of businesses which had not thought of mass production before adopted it. The output increased manifold and the ingenious system of instalment buying was extended in order to permit the production to go into immediate consumption, so that the pace of the exacting machines might not be relaxed. In the United States the method was carried to such a pitch that economists began to show uneasiness. The industrial world, they said, was mortgaging its future; the people, by buying with money they had not got, the manufacturer and merchant by selling for a promise to pay. Nevertheless, America vaunted the success of the system. She flourished exceedingly, whilst Europe was beginning to feel the approaching "slump." Then came the crash. The world stopped buying and the mass production machine was put out of joint. Economists saw, what Mr. Garrett had foreseen, that the success of mass production hung upon mass consumption; that the supply of orders to the insatiable machines must never cease, and that humanity must buy, buy, buy, whether it wanted to or not, or see the whole system fall to the ground.

Mr. Edward A. Filene is the President of one of the biggest retail stores in America. He is regarded as a pioneer in the application of scientific methods and efficient organisation to retail distribution, and he is an out-and-out Fordian. He has just published a book entitled "Successful Living in this Machine Age" (Jonathan Cape), which is designed to show the conditions which mankind must observe if it desires to live happily under the domination of the machine. It is an interesting book, written on lines which many American authors have followed, but starting from a rather different standpoint. Like his predecessors, Mr. Filene seems to regard mass production as something new, something invented by Mr. Henry Ford. That is rather curious in a general merchant, who must have handled mass-produced articles, from beads and brooches, through kitchen utensils, up to fabrics and furniture, for years past. His book differs from others in that it is not written, as they are, from the manufacturer's point of view, but from that of the distributor. The result is that he continually lays emphasis on the snap definition "Mass production is production for the masses." If things are not cheap, he contends, they cannot be sold, and they can only be made cheap by producing then in the mass. He recognises, however, that to sell in great quantities there are two essentials: first, that the merchant should do his business thoroughly; and secondly, that the people should have enough money to spare for expenditure on more than the mere necessities of life. The former of these two requirements calls for the development of the science or art of distribution; the latter for the payment of higher wages, so that the producers themselves may be the best customers. That was, of course, said by Ford long ago, and the practice of it in his works made him unpopular with other manufacturers who did not accept his hypothesis. Events have shown that it is only true up to a certain point; when general business fell away Mr. Ford could not fend off the decrease of his output by paying his workers higher wages; he was in fact obliged to reduce them as his rate of production fell. Not all the efforts of the best selling brains in America could maintain the demand when the depression came, and mass production went as certainly to the wall, probably

more certainly, than production on a smaller scale with smaller plant and lower rates of wages. Mass production, it is manifest, cannot create prosperity. It demands a constant flow of large orders, and if that flow is interrupted it is thrown out of gear. Hence it is really dependent on salesmanship; the art of making people buy what you want them to buy, whether they want to or not. That again would appear to be controlled by forces which the economists of the two hemispheres are unable to control. There is no reason to suppose that the people of America are less susceptible to the blandishments of the arch salesman than they were a few years ago. Yet they are not able to or will not buy, and unemployment mounts up because the people are no longer supporting the mass producing factories and giving themselves the employment that would provide them with the means of purchasing more. That is a very curious position, which inevitably leads one to wonder if the apparent vast success of the American system—production for the masses and deferred payments—was not due to an external factor over which the manufacturer has no control. The system is still there. If it really *produced* prosperity then there is no obvious reason why the United States should have rapidly advanced towards an industrial decline which is even worse than that of the Old World.

Mr. Filene's book has so many chapters of interest that we hope to find an opportunity to deal with it at greater length in a later issue, but there is one further observation that we desire to make now. Mr. Filene seems to foresee the time when Europe will take up mass production, with high wages, as fully as America has done. It is of interest to consider the result. To succeed the products must be cheap. Now there are parts of Europe which are quite capable of doing all that America has done, but with a much lower wage rate. Assuming that all other charges are the same, it is obvious that their total cost of production would be lower than the American total cost, and that in open competition America would be undersold every time. Hence America could not hope to hold a place upon neutral markets save by "dumping" or by reducing her own standard of wages. She is in the fortunate position that she can afford to do without foreign trade. We are not in that position, and the arguments in favour of high wages which appear to be so convincing in the other side of the Atlantic do not, and cannot, carry so much weight here. "High wages means high prosperity" is an admirable motto as long as you have not to compete with someone who knows all that you know, can do all that you can do, and pays less, directly and indirectly, for the doing of it. This country—the home of the spinning jenny and the power loom—was the pioneer of mass production—Production for the Masses. It knows that mass production is an essential in certain industries, but its hundred years of experience has convinced it that all the claims which America advances cannot be substantiated. Mass production is not a panacea. The absence of it may destroy prosperity, but the existence of it, as we see in the United States to-day, will not prevent a depression, avert unemployment, and lead to the continuation of success at a time when the world is not prepared to take the vast outputs which are the prime element of the system.

Nikolaus August Otto.

JUBILEES and centenaries follow one another so quickly nowadays that we are apt to pay them little attention; they do serve, however, to remind us of what we owe to those who have passed on before us. Especially is this so in the case of Nikolaus August Otto, the pioneer of the four-stroke cycle gas engine, the centenary of whose birth was commemorated at Cologne on Tuesday last, June 14th, by the local branch of the Verein deutscher Ingenieure. In the morning of that day a visit was paid to the cemetery of Melaten where Otto is buried, and wreaths were deposited on the grave by the Verein and by other bodies, including the Newcomen Society for the Study of the History of Engineering and Technology, to mark the international character of Otto's work. In the evening at 6.30, in the Hall of the Verein, Dr.-Ing. Arnold Langen, descendant of Otto's famous partner, pronounced a memorial oration; his speech was broadcasted on the wireless.

Although in the visualisation of the cycle Otto was anticipated by Beau de Rochas—1862—yet to Otto we owe the practical working out of the greatest single improvement that has been made in the gas engine, the compression of the explosive mixture in the cylinder prior to ignition, whereby a dilute mixture can be fired, giving a quiet explosion and sustained pressure during the working stroke. This is only achieved with one explosion in every four strokes of the piston, but the unequal turning effort may be smoothed out by a fly-wheel. Whatever its defects, the cycle remains to-day the commonest one for internal combustion engines. Otto and his associates—Eugen Langen (1833–1895), an engineer of experience with capital; Gottlieb Daimler (1834–1900), subsequently the motor car pioneer; and Wilhelm Maybach (1846–1929), of carburetter fame—were at this time, 1876, in the heyday of their powers, unhampered by tradition, and constituted a galaxy of talent which has shed lustre on the Rhineland and on Germany. Their high standard of workmanship, said Dr. Langen, removed from German productions the slur "billig und schlecht"—cheap and nasty—pronounced upon them by a renowned German himself.

Otto was born in the village of Holzhausen, in Nassau, where his father was the innkeeper and posting-master. His school education only lasted till the age of sixteen, when he left home to start a commercial career in Cologne. Newspaper reports about Lenoir's gas engine fired his imagination, and led him to the construction, with the aid of a clever mechanic, of his first "atmospheric" engine, patented between 1861 and 1864. There are still some of us who can remember that fearful and wonderfully noisy machine, with its free piston shooting up the vertical cylinder. Perhaps the most important event of this period was the happy meeting in February, 1864, of Otto with Langen, names to be associated for all time with the gas engine. The firm N. A. Otto et Comp. was established on March 31st, 1864, in Cologne, with a workshop in Servaesgasse 2. Its first success was at the Paris Exhibition of 1867, where the engine got the gold medal in its class. Increasing business led to the formation in 1872 of the Gasmotorenfabrik Deutz A.G. In a corner of the shop Otto went on experimenting, and in November, 1876, one of the new "silent"—the word speaks volumes—four-stroke horizontal engines was at work. This engine is preserved in the museum of the firm, now the Humboldt-Deutz-Motoren A.G. The design was covered by the well-known German patent of August 4th, 1877. At the Paris Exhibition of that year it was premiated, and set all the world talking. By the end of 1880 upwards of 2600 engines had been made by the Deutz firm alone. In England at an early date Messrs. Crossley Brothers began making the engines under licence. The first English atmospheric and an early silent example are preserved in the Science Museum, South Kensington. In the United States the firm of Schleicher, Schumm and Co., of Philadelphia, was formed in 1877 to work the Otto patents in America. In France the Compagnie Française des Moteurs à Gas et des Constructions Mécaniques began business in Paris in 1879.

Otto did not live to see all the developments and applications of his invention to spirit, and light and heavy oil, for he died on January 26th, 1891. With him departed a pioneer who by untiring labour made a permanent mark on world engineering.

Literature.

Dynamics of Engine and Shaft. By RALPH E. ROOT, Ph.D. London: Chapman and Hall. 1932. Price 18s. 6d.

PROBLEMS in the dynamics of engines are most easily solved by a judicious blending of graphical and analytical methods. Graphical methods are, as a rule, less laborious than analytical, whereas analytical are clearly the more exact. But, in all problems which arise in practice, due regard must be paid to the probable percentage error in the data which are obtained by measurement or experiment, and this error will limit the degree of accuracy in any results obtained therefrom. The application of too exact analytical methods to such data not only may give unnecessarily laborious calculations, but may suggest a degree of accuracy in the results which is beyond that rendered possible by the data.

The author of this book is a Professor of Mathematics and Mechanics, and perhaps it is not surprising, therefore, that he should prefer to treat the subject wholly analytically and that graphical methods should be excluded. But probably the book would be more acceptable to engineers if the use of the drawing board had been recognised, although only to a very limited extent, and a graphical treatment of some of the problems might have proved a welcome relief from mathematical expressions which sometimes occupy half a page and suggest that analysis has been carried to a degree of exactitude which is seldom, if ever, required in the solution of engineering problems.

In many problems mathematical analysis is the only method which can be applied with success; but it is not necessary, nor even advisable, to treat every problem and every part of a problem analytically, and the engineer is likely to look with less favour upon a book which deals thus with problems which he has been accustomed to solve rapidly on the drawing board and for which he knows that a graphical treatment is not less accurate than the data supplied. Thus, in the chapter on "Turning Moments," it is desired to obtain the pressure on the piston as a function of crank angle. The author explains that the pressure P on the piston at any point in the stroke is obtained from an indicator card, and that it is necessary to find the value of P for any position of crank. "This," says the author, "is readily accomplished by the use of equation (5)." Equation (5) gives piston displacement in the form of a Fourier series.

The book deals with the balancing of dynamical forces and couples of engines, turning moments of shafts, the pressure on and friction losses at bearings, the torsional and transverse vibration of shafts and the critical speed of shafts. The analytical treatment of these problems is clearly set forth and most of the argument can be followed by those possessing a degree of mathematical knowledge common to the modern engineer. The book should prove of use to those who have to deal with the troublesome vibrations which are the accompaniment of the ever-increasing speed of the modern engines.

Bauxite and Aluminous Laterite. By CYRIL S. FOX, D.Sc., M.I.M.E., F.G.S. Second edition, partly rewritten and enlarged. London: Crosby Lockwood and Son. 1932. Price 30s. net.

THIS is the second edition of a book which we reviewed in October, 1927, and the good opinion which we then expressed of it has been confirmed by the fact of a second edition being required. The author has added a second name to the title, and speaks of this edition as being partly rewritten and enlarged. The enlargement is very slight; both books have 312 pages, but the second contains an additional introduction of thirty-one pages, which are not included in the above pagination, though it is true that a part of them is taken up by a reproduction of the preface to the first edition. Indeed, this edition is an exact reproduction of the first 240 pages of the first edition, there being some alterations in the following thirty pages, though such alteration has not extended to the length of correcting such obvious misprints as Tronghjem and Xenthosiderite. Again, there is a statement in the first edition that an aluminium works was commenced at Lausitz in 1917, and this statement is simply repeated in the present volume, although one would imagine that in the fifteen years that have elapsed these works must either have been built or the work abandoned. The new edition contains, however, some ten additional photographs, all from European localities, whilst the number of sketches has been considerably reduced. We can only repeat what we said of the first edition, that it forms a valuable book of reference for all interested in the subject of bauxite.

BOOKS RECEIVED.

A Shipbuilding History, 1750–1932. Glasgow: Alexander Stephen and Sons, Ltd., Linthouse, Govan.

The Motor Repair Manual. Sixth edition. London: The Temple Press, 5–15, Rosebery-avenue, E.C. 1. Price 2s. 6d. net.

Introduction à la Mécanique des Fluides. By Professor A. Foch. Paris: Collection Armand Colin, 103, Boulevard Saint Michel. Price 10·50f.

The Installation of a Production System in the Locomotive Workshops at Moghalpura. By A. S. Howell, A.M.I. Mech. E. Calcutta: The Manager, Government of India Central Publication Branch. Price 3s. 3d. net.

ELECTRICAL MANUFACTURERS AND THE FRENCH QUOTA.

IT has now been arranged with the French Government that exports to France of electrical goods which are subject to quota restrictions on import into France are to be accompanied by certificates issued by a trade organisation in this country. Such goods will not be admitted into France unless they are accompanied by such a certificate. The British Electrical and Allied Manufacturers' Association, 36, Kingsway, W.C. 2, has been chosen as the appropriate body for issuing such certificates for electrical goods and apparatus, and all applications for these should be addressed to it.

Blank notification-of-order certificates will be supplied to manufacturers, and on receipt of an order for goods two copies will require to be filled in and sent to the Association's offices. One copy will be retained by the Association and the other sent on to the appropriate French *Syndicat*.

Applications for French import certificates have to be made to the Association within thirty days of the due date of delivery. Goods which come under the new quota regulations are as follows:—Dynamo-electric machines and industrial electric transformers, dry or in oil; dynamo-electric machines for motor vehicles of all kinds (except those combined with ignition apparatus for explosion engines); current rectifiers; apparatus for cutting off, regulating, protecting, and distributing electric current, including electric distribution tables, whether fitted up or not; electric accumulators of all kinds and their component parts; certain electric measuring instruments and transformers for same.

The British quota in its major portion, it has been decided, is to be divided between interested British firms in proportion to their deliveries during 1931, and information has been already asked for to enable the quotas to be allocated.

The system comes into force on July 1st. Any further information can be obtained from the Association at 36, Kingsway, W.C. 2.

An Interesting Bridge Replacement Operation.

DURING the last five or six years a considerable number of iron railway bridges have been replaced on the Italian State Railways by new ones, generally of steel, built in accordance with modern conceptions and taking into account various physical constants, the importance of which had not been realised at the time when the old bridges were constructed some forty or more years ago. In many cases the old bridges were quite unsuitable for carrying the present-day heavy trains and engines, nor could they withstand the increased speed of electric trains. The substitution of the old bridges by new structures without interfering with the traffic has developed almost into a scientific craft, and a specialised and highly skilled staff of engineers and men, whose experience has grown with the increased practical work, is now doing the work as if it were a simple matter offering no difficulties whatever.

Of unusual interest is the replacement of the old railway bridge over the Taro, on the Sarzano-Parma line, not only on account of its length, but particularly on account of its curved shape and obliquity. Photographs illustrating the sequence of operations are reproduced on page 668. The bridge crosses the river in the vicinity of the station of Borgotaro, at a spot where the river bed has a width of over 400 m. (1320ft.). The old bridge consisted of seven iron spans, each 50 m. (165ft.) in length, between the centres of the piers; two brick arches of 9 m. (30ft.), each at the Borgotaro end; and three brick arches of 9 m. each at the Parma end. Over the length of five iron spans and the three brick arches at the Parma end the bridge forms a curve of 20 chains radius. The whole bridge is on a slight gradient and is about 42ft. above the river bed. The unusual difficulties which had to be overcome in the substitution of the seven iron spans can be judged from the following description of the work.

A considerable amount of preparatory work was necessary. It consisted of the erection of the new steel spans alongside the old in a position such as to allow them to be transferred to their new positions contemporaneously with the removal of the old spans by causing both bridges to slide upon specially constructed transfer tables fitted with rollers running between two sets of rails, of which one set—the lower one—was mounted on the piers and the upper one fixed to the girders themselves.

In view of the curved shape of five spans—a length of 250 m. (825ft.)—it was evident that the travelling direction of the girders could not be perpendicular to the axis of the single girders. It was therefore decided to place the new bridge in such a position that its travelling direction would be perpendicular to a chord connecting the ends of the curved sections.

The laying out of the individual sliding tracks of each girder had to be done with the greatest precision; if the axis of each track had not been exactly parallel to that of every other track even the slightest deviation would have rendered it impossible to fit the whole new bridge within the space between the brick arches at each end.

In order to establish the exact position of the axes of the sliding tracks, lines parallel to the above-mentioned chord were traced in the river bed and the perpendiculars to them established in correspondence with the pillars of the bridge by means of theodolite observations. These perpendiculars, defining the axes of the sliding tracks, were then pegged out and their positions parallel to one another verified by direct measurements. The fact that the piers themselves are disposed radially, whereas the girders had to be moved parallel to one another, made the construction of the wooden supports somewhat complicated. In the case of straight steel bridges it is an easy matter to place the new girders in the correct relative position prior to their transfer. In the present case, however, the curved shape of the bridge complicated matters and the placing of the girders required repeated and most exact adjustments in order to ensure that they should fit exactly when the transfer over the distance of 6·34 m. (21ft.) had been completed. Views of one of these wooden supports can be seen in the accompanying engraving.

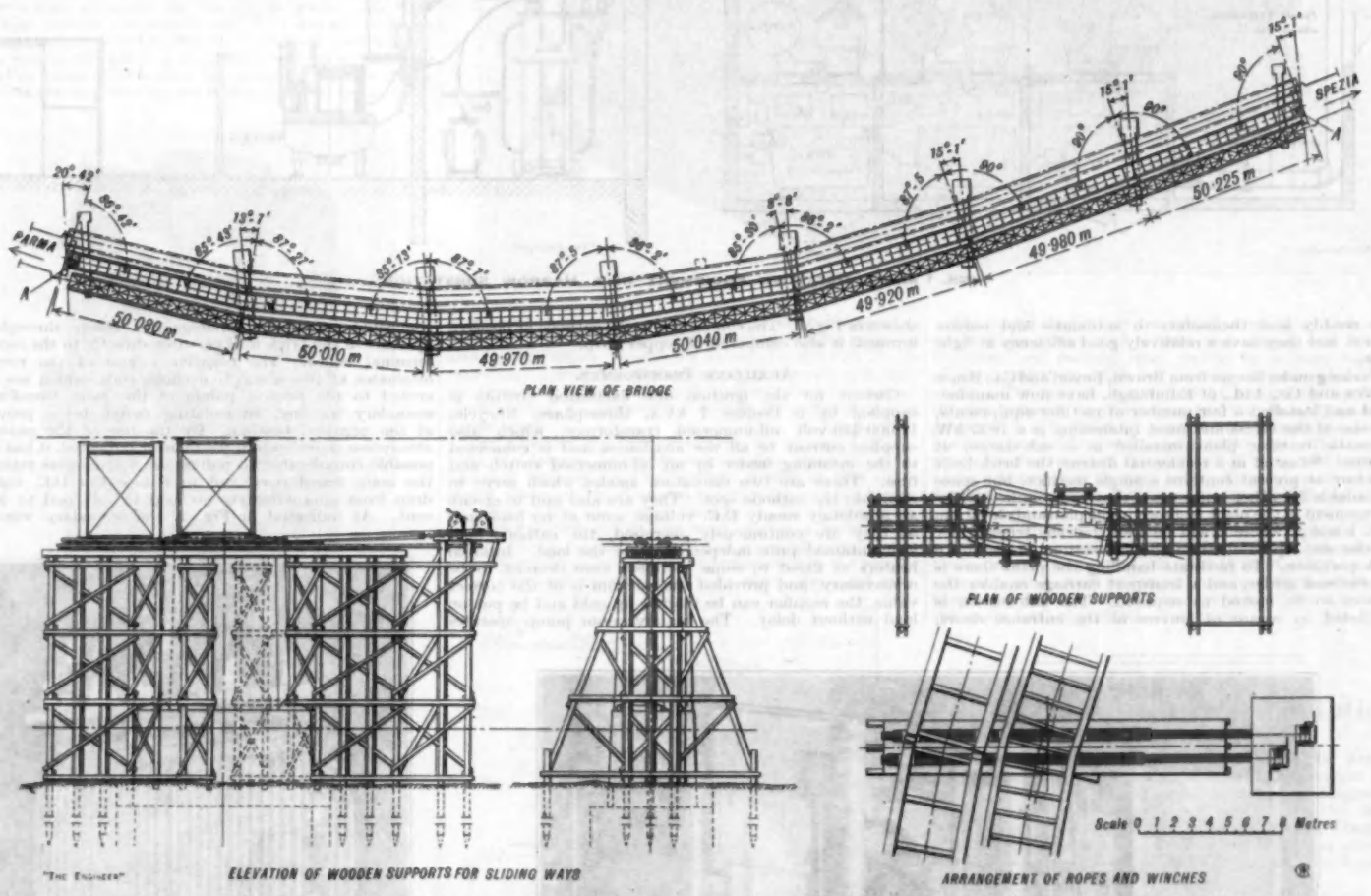
Owing to the curved shape of the bridge another preliminary operation became necessary: the extremities of the old girders had to be cut away, since otherwise the ends would have jammed against the masonry pillars of the brick arches, which are not, of course, parallel to the direction of motion of the bridges—see the engraving. The cutting away of the extremities of the old iron girders made the erection of temporary wooden supports necessary, both for the girder ends and for the rails. Both were constructed in a manner which permitted their removal in a few minutes at the termination of the transfer.

Fourteen roller transfer tables were used, one at each end and two at each pier. They were composed each of twenty-seven rollers, 124 mm. (4⅞in.) in diameter and 600 mm. (24in.) long. The rollers ran between two sets of rails, each set consisting of four rails, the sets being fixed as explained above. The rails composing the upper set were connected with one another and constituted during the transfer operation the only connection between the old and new girders.

The transfer of the new girders and removal of the old ones was effected by means of fourteen hand-driven winches which were mounted on the wooden supports. The wooden supports and the arrangement of the winches can be seen in the line engraving. Each winch was fitted with three purchase pulleys with steel ropes 20 mm. in diameter. One pulley block was attached to the extremity of the upper rail set, the other was anchored near the winch at a point opposite the lower rail set. The maximum pulling effort on the rope was estimated at 2000 kilos. on the basis of practical experience gained on previous occasions by inserting dynamometers between the pulley blocks and the point of junction with the upper and lower set of rails respectively.

For the purpose of co-ordinating the operations and the signalling and the transmitting of orders, which, owing to the length of the bridge, it would have been impossible to do by the use of megaphones, a central erection was built up at the centre of the bridge on a special scaffold, and each of the bridge piers was equipped with a signalling apparatus consisting of a disc mounted upon a pulley. A hemp rope was wound round the pulley and attached by one end to the old girder, whilst the other end carried a weight of 11 lb. Any movement of the girder caused the rope to move and the disc to rotate. On the disc a copper ring was fixed with which two brushes made contact. When the disc rotated, owing to the forward movement of the girder, one brush remained permanently in contact with the copper ring, whilst the other, being placed in correspondence with a number of sector pieces, alternately opened and closed the electric circuit as the bridge slid forward. Ten centimetres of forward movement of the girder caused the contact to open and close. This intermittent contact caused corresponding lamps at the central device to light up or go out. Each pier was also connected by telephone with the central apparatus, where a special switch permitted connection to be made either with any one of the pillars or simultaneously with all. The central apparatus was further equipped with eight ruled ribbon indicators, which were pulled out by hand in accordance with the light signals so that the exact position of all the girders was visible at a glance.

The transfer operations were executed in two intervals between trains. During the first interval from 7.35 to 10.10 a.m. the temporary wooden understructure, upon which the old girders had been placed, was removed by means of eighteen hydraulic jacks. The girders were then placed upon the roller transfer tables, which were securely fastened and anchored in order to allow the next train to pass. After its passage the actual transfer took place within the following time limits:—23 minutes were required for disconnecting the rails and removing the temporary supports at the extremities of the girders; the transfer of the new girders to the place of the old girders and the simultaneous removal of the latter occupied 24 minutes; 110 minutes were required for transferring the weight of the old girders from the roller tables on to the temporary wooden supports; at the same time the rails were jointed and the bridge track rectified; 10 minutes were required for the preliminary tests with two engines. It is interesting to note and indicates the very careful preparation of the whole transfer that the times occupied corresponded exactly with those calculated in advance. The whole operation was executed without the slightest hitch.



PLAN OF BRIDGE AND DETAILS OF WOODEN SUPPORTS AND WINCH GEARS

DR. T. W. CHALMERS.

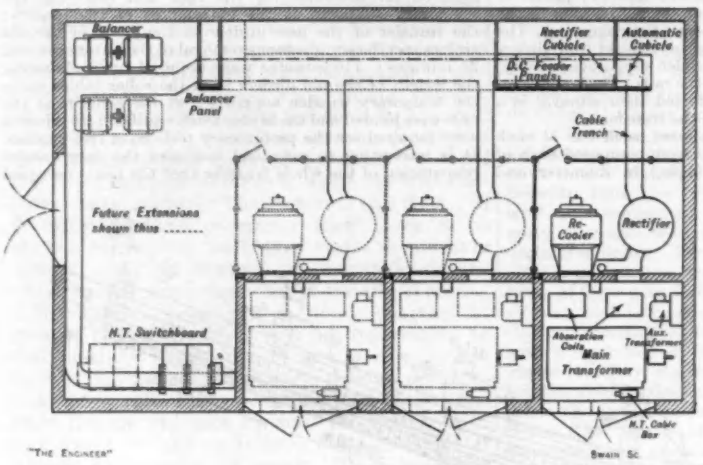
THE Editor desires to offer his heartiest congratulations to Mr. T. W. Chalmers, his Chief Technical Assistant, upon whom was conferred the degree of Doctor of Science, on Wednesday last, at a Commemoration Day Meeting of the University of Glasgow. Dr. Chalmers served his apprenticeship at the Hyde Park Works of the North British Locomotive Company, Ltd., and studied under the late Dr. Archibald Barr at Glasgow University. He graduated as a Bachelor of Science in 1908 and since 1909 has been a member of the editorial staff of THE ENGINEER. His thesis for the doctorate degree was entitled "The Automatic Stabilisation of Ships, with Particular Reference to the Use of Gyroscopes for the Purpose of Controlling, Reducing, or Eliminating Rolling Motion." It consisted of an elaboration and development of a series of articles which he wrote and which were published anonymously in our columns during April, May, and June, 1930.

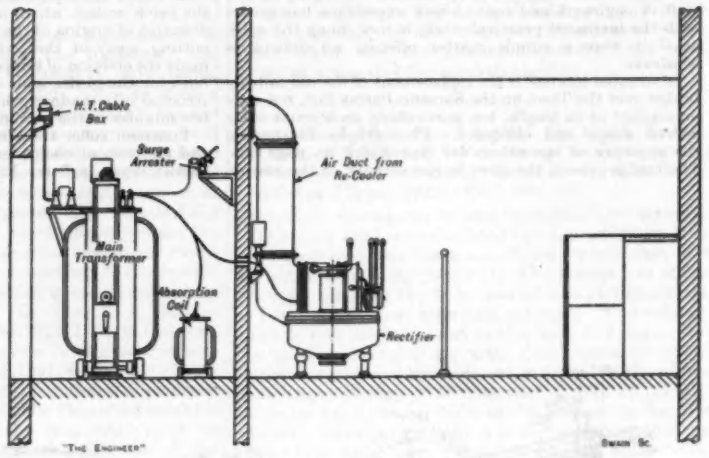
IN a paper presented to the Physical Society, A. O. Rankine gives an account of a series of observations with a Shaw and Lancaster-Jones gravity-gradiometer during which it was discovered that very persistent, although small, electric charges could be developed on the mica ring forming part of the oscillation-damping system, and lead to spurious results in the normal use of the instrument. The effect can be effectively eliminated by introducing into the instrument a sufficient quantity of a suitable ionising agent, such as mesothorium.

A 1000-kW Automatic Rectifier Equipment at Harrow.

SINCE the first metal-cased power rectifier was put into service in this country, considerable progress has been made in the development and use of plant of this nature, which will undoubtedly be widely employed in the future, both for traction and general supply purposes where D.C. distribution is in vogue. The advantages claimed for rectifiers should now be well known. With the exception of the small auxiliaries there are no moving parts and where noise is objectionable rectifiers are generally preferable to rotary converters and similar machines. Other advantages are that they do not call for massive foundations; they readily lend themselves to automatic and remote control, and they have a relatively good efficiency at light loads.

Working under licence from Brown, Boveri and Co., Bruce Peebles and Co., Ltd., of Edinburgh, have now manufactured and installed a fair number of rectifier equipments, and one of the latest and most interesting is a 1000 kW automatic rectifier plant installed in a sub-station at Harrow. Situated in a residential district the brick-built structure at present contains a single rectifier, but space is available for other units when they are required. The arrangement of the plant is shown in the plan and elevation, Figs. 1 and 2, where it will be seen that the transformer cubicles are separated from the sub-station proper by a brick partition. To facilitate handling the plant there is an overhead girder, and a transport carriage enables the rectifier to be moved as required. The sub-station is ventilated by means of louvres at the entrance doors, and before passing to the outside of the building the air is circulated over the tops of the transformer cubicles by an outlet duct from the re-cooler so as to assist in cooling the transformers.





FIGS. 1 AND 2—RECTIFIER EQUIPMENT IN A HARROW SUBSTATION

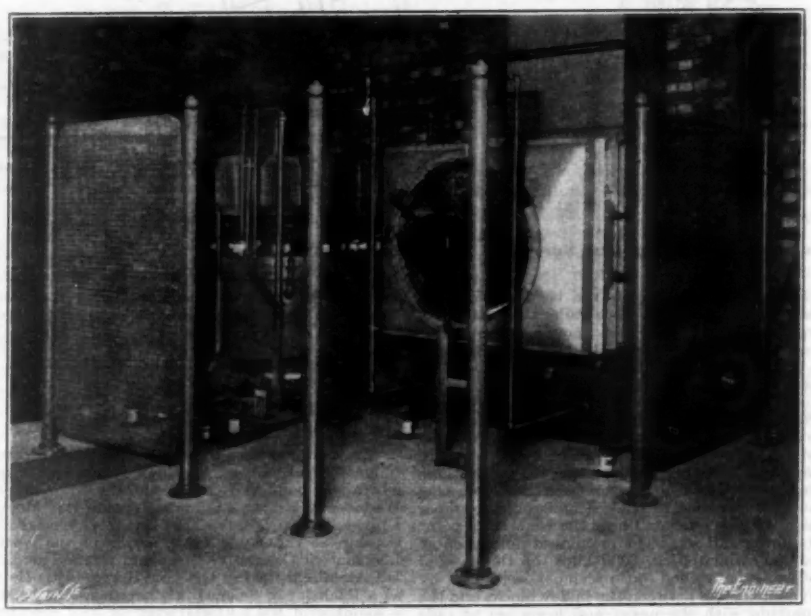


FIG. 3—TWELVE-ANODE RECTIFIER AND RE-COOLER

RECTIFIER.

The Peebles-Brown-Boveri twelve-anode rectifier shown in Fig. 3 is designed for a normal load of 2100 ampères at 450/500 volts, and is capable of dealing with overloads of 25 per cent. for two hours and 100 per cent. for fifteen seconds. In this particular case the primary vacuum pump driven by a small A.C. motor is mounted separately on an insulated base, but it is possible to place this auxiliary directly on the rectifier cylinder, thus making a self-contained unit. The small motor driving this pump is insulated from the base-plate and is fitted with an insulated coupling. The high vacuum pump is mounted directly on the rectifier immediately above the preliminary pump set. The rectifier cylinder is composed of welded steel plates specially treated to remove all dirt, and the vacuum seals are of the mercury type, which enable leaks to be detected by the sinking of the mercury in the indicator gauge fitted to each joint. Whilst the leak lasts nothing but mercury can gain access to the arc chamber, and it merely adds to the amount of mercury in active use. The twelve anodes are carried by a substantial steel plate, which can readily be removed to permit the interior of the rectifier to be inspected. The complete rectifier stands upon insulators mounted directly on the floor. Strips of copper form the connections to the anodes and are brought out to a terminal board mounted on the outside of the top half of the rectifier in a convenient position for connecting up to the cables coming from the secondary winding of the transformer shown in Fig. 4. The connection to the cathode or positive terminal is also composed of copper strip.

AUXILIARY TRANSFORMER.

Current for the ignition and excitation circuits is supplied by a Peebles 7 kVA, three-phase, 50-cycle, 11,000/220-volt oil-immersed transformer, which also supplies current to all the auxiliaries and is connected to the incoming feeder by an oil-immersed switch and fuse. There are two excitation anodes which serve to maintain the cathode spot. They are also said to ensure an absolutely steady D.C. voltage, even at no load, and as they are continuously energised, the cathode spot is maintained quite independently of the load. Internal heaters as fitted to some rectifiers were deemed to be unnecessary, and provided the vacuum is of the correct value, the rectifier can be started up cold and be put on load without delay. The high vacuum pump operates continuously, irrespective of whether the rectifier is working or not.

COOLING PLANT.

A Heenan and Froude re-cooler consisting of a fan-cooled radiator and motor-driven water-circulating pump, mounted on insulators at the side of the rectifier, as shown in Fig. 3, serves to keep the rectifier cool and provides the water necessary for the condensation of the mercury vapour in the high-vacuum pump, the same water being used continuously. In the illustration, Fig. 3, three of the expanded metal screens which enclose the plant have been removed. As the D.C. is distributed on the three-wire system, a Peebles rotary balancer has been provided and is capable of dealing with an out-of-balance current of 300 ampères. The set consists of two protected type D.C. shunt-wound, 500 r.p.m. machines, directly connected and mounted on a combination bed-plate. It is automatically controlled by means of solenoid-operated circuit breakers and contactors, and is started up immediately the rectifier main circuit breaker is closed. The main and balancer circuit breakers are interlocked, so that when the rectifier shuts down the balancer is automatically tripped out.

MAIN TRANSFORMER.

The Peebles oil-immersed transformer—Fig. 4—which operates in conjunction with the rectifier, is supplied with three-phase, 50-cycle current at 11,000 volts, and is provided with motor-operated on-load tap-changing gear to give the necessary D.C. voltage variation. It is situated in the transformer cubicle, together with the auxiliary transformer and absorption choke coils and the cables from the twelve phases of the double six-phase connected secondary windings are taken through an aperture in the brick wall partition directly to the rectifier terminal board. The negative circuit of the rectifier originates at two absorption choke coils, which are connected to the neutral points of the main transformer secondary winding, an isolating switch being provided at the negative bus-bar. By the use of the patented absorption choke coils in the manner indicated, it has been possible considerably to reduce the volt-ampère rating of the main transformer and to reduce the D.C. voltage drop from approximately no load to full load to 5 per cent. As indicated in Fig. 2, the secondary windings

FIG. 4—TRANSFORMER

of the main transformer are protected against the possibility of surges by horn gap arresters.

REMOTE CONTROL APPARATUS.

The rectifier is controlled from the main sub-station about a mile distant, and it operates in parallel with rotary converters in that station, the remote control apparatus being similar to that used for the converters. The 11,000-volt incoming supply is received by a Reyrolle motor-operated oil switch, with overload protection having instantaneous and inverse time limit characteristics. The control panel shown in Fig. 5 performs the starting up and shutting down operations and provides for the complete protection of the plant after the starting impulse has been given from the remote end. The control panel is fitted with a vacuum gauge and main transformer step switch indicator, and with switches for changing over to manual control. At the control station the remote control panel has push-buttons for starting up, shutting down, and for raising and lowering the pressure. Remote control meters give load and voltage conditions, and signals are provided for indicating "plant running," "shut down," and "cooler fault." The starting impulse for the rectifier sub-station is given by depressing a "start"

push-button, which actuates the relay for closing the high-tension switch, which energises the main transformer and, at the same time, the relay closes the D.C. circuit breaker with a time lag to ensure that it cannot close before the oil switch. By means of auxiliary contacts the ignition and excitation apparatus is energised simultaneously with the closing of the oil switch, thus starting the ignition and excitation automatically. The rectifier is then ready for service, and provided the D.C. voltage of the rectifier is higher than the bus-bar pressure, the plant will immediately pick up load. Remote control of the motor-operated tap-changing gear on the main transformer enables the operator to secure perfect paralleling. By means of these tappings a 16 per cent. voltage variation can be obtained in sixty-six steps, which give very smooth control. The high-tension switch is interlocked with the step switch and is immediately tripped in the event of the step switch remaining in an intermediate position between two tappings.

VACUUM CONTROL.

The correct vacuum is automatically maintained by contacts on the vacuum gauge, which controls the starting up and shutting down of the preliminary vacuum pump. The needle of the vacuum gauge also causes the rectifier to be "locked out" in the event of the vacuum being too low for satisfactory operation, whilst, should the temperature of the rectifier exceed a predetermined limit, it is shut down by a contact thermometer mounted on the anode plate. If, after the high-tension oil switch and D.C. circuit breakers have tripped, a second attempt to close them should prove unsuccessful, the plant is shut down and an appropriate signal is given at the main sub-station. Failure of the re-cooler fan or pump motors is also signalled to the main

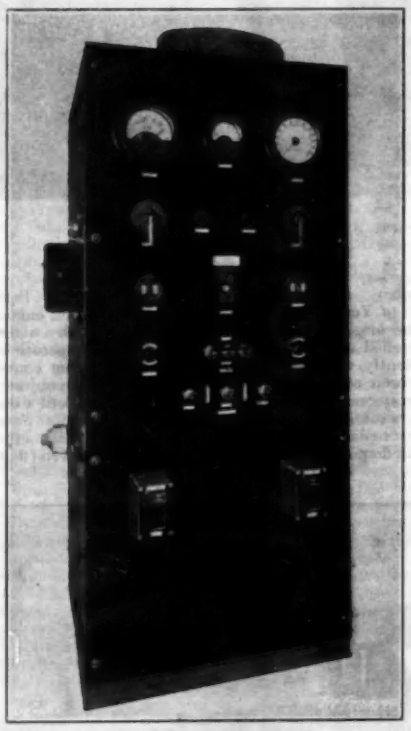


FIG. 5—CONTROL PANEL

sub-station and at the same time the relay for the vacuum pump is made to open the heating plate circuit of the high-vacuum pump, but immediately the fault is removed the heating plate circuit is again energised. The D.C. Bertram Thomas feeder switchboards are adjacent to the rectifier circuit breaker and automatic panel, the feeders being connected to the bus-bars by double-pole hand-operated circuit breakers with overload features and isolating switches.

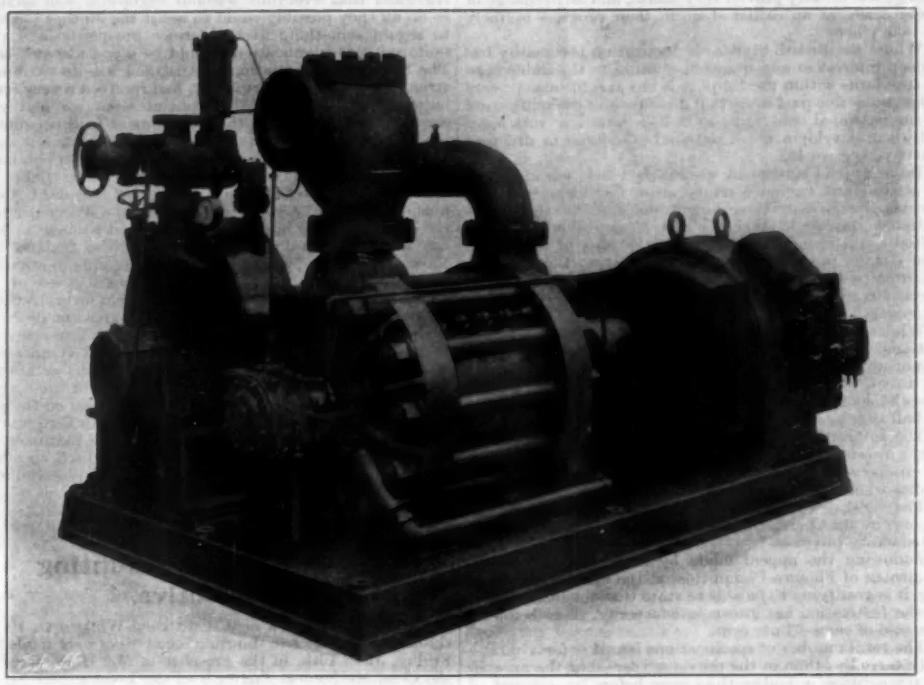
The remote control system described seems to be accepted practice for lighting and power systems, whereas, on tramways, the rectifier is put into service when the D.C. voltage near the sub-station decreases owing to an increase in load, and is switched out again when the load drops to a predetermined value. The plant described was designed and built to the order of the Harrow Electric Light and Power Company, Ltd., and has been installed at College-road.

A Turbo-Electric Feed Pump.

IN general, it is more economical in a modern power plant to drive the boiler feed pumps by electric motors rather than by steam turbines. Unless special provisions are made, however, the electric motor can only give a constant speed drive, and this fact introduces a loss of efficiency. The characteristic of a typical centrifugal feed pump running at constant speed is given in curve A, below, which also shows in curve B the total resistance, comprising the boiler pressure and the resistance in the pipe line, valves, &c., to be overcome. The vertical distance between curves A and B represents the throttling effect of the boiler check valves. The pump is designed, of course, to perform its maximum duty with as little throttling at the check valve as is safe. At the light load end of the scale, however, this arrangement, as can be seen from the curves, involves a very considerable throttling loss. If a turbine drive is adopted the pump can be governed by means of a simple spring-loaded pressure

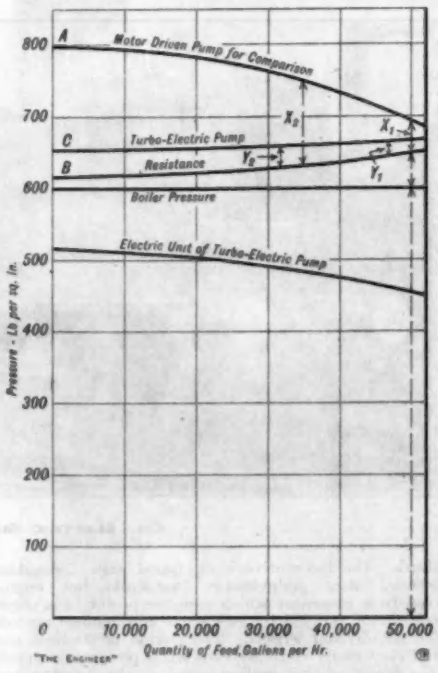
TURBO-ELECTRIC FEED PUMP FOR SPONDON POWER HOUSE

G. AND J. WEIR, LTD., GLASGOW, ENGINEERS



governor to run at variable speed and deliver against a pressure that is nearly constant, and which may be arranged to follow closely the curve of resistance to be overcome—curve B. Unfortunately, however, although the throttling loss at the check valves is thus reduced to the minimum, the economy of driving the pump by steam power is low.

The difficulty has been overcome by G. and J. Weir, Ltd., of Glasgow, by combining the two forms of drive. The firm recently installed a plant similar to that illustrated above at the Spondon power station of the Derby and Notts. Electric Power Company. It is capable of delivering 50,000 gallons per hour against a boiler pressure of 350 lb. per square inch, and a second pump of the same type is to be installed in the extensions to the power-house now under construction. In effect, the plant con-



PUMP CHARACTERISTICS

sists of two pumps connected in series, the larger and more powerful of which is driven by an electric motor, while the smaller is turbine driven. The turbine-driven pump is connected on the suction side of the other, and its speed of rotation is governed by the water pressure in the main feed water range. The effect of thus combining two pumps may be seen in curve C, although the characteristics therein shown do not apply to the Spondon installation. It will be seen that the characteristic of the turbo-electric pump follows closely the curve B of resistance to be overcome and reduces to a minimum the throttling losses in the boiler check valves. The work done by the turbine-driven pump is represented by the vertical distance between curve C and that representing the constant-speed characteristic of the electric unit alone. The turbine-driven pump speeds up and takes a greater share of the load when the demand upon the pump increases. The high efficiency of the electric pump is in this way combined with the flexibility of the steam-driven pump.

The turbo-electric set for Spondon consists, first, of a single-stage pump with a cast iron casing and bronze impellers, and packing rings, driven by a steam turbine of the impulse type with one pressure and several velocity stages. The turbine is governed by a regulator operated by the pressure in the boiler feed range and a safety governor is also fitted to prevent the pump exceeding a predetermined safe speed—about 6000 r.p.m. The electric pump has five stages of the ring section type, held together by long heavy steel through bolts. It is driven through a flexible coupling by a B.T.H. motor of 320 H.P., and runs at 1480 r.p.m.

By thus dividing the feed pump into two separate units, it is sometimes possible to place feed heaters between the two pumps. The heaters can then be built of lighter construction, since they no longer have to withstand the full discharge pressure of the feed pump. This fact constitutes a further possible advantage.

The British Standards Institution.

AT 11.30 a.m. on Thursday, June 9th, the annual general meeting of the British Standards Institution was held in the Hall of the Institution of Mechanical Engineers, with Mr. Maurice Wilson, the President, in the chair. Besides the election of the three Divisional Councils (Engineering, Building, and Chemical) and other routine business, a short statement of the progress of the Institution's work was presented.

Last year it was necessary, owing to the reorganisation which was then in progress, to delay the annual meeting until November, although the financial year is from April 1st to March 31st, so that the present report on the work done covers a somewhat shorter period than usual. The financial statement however, covers the full year. It is hoped to arrange in future for the annual meeting to be held in July.

Immediately following the last meeting the Director, Mr. C. le Maistre, left on a visit to the Dominions of Australia, New Zealand, and Canada. It will be remembered that it was then reported that this visit was being made at the invitation of the New Zealand Government, with the support of the Home Government through the Empire Marketing Board, to further the desire expressed at the Imperial Conference of 1930 for the close co-operation of the various standardising bodies throughout the Empire. Mr. le Maistre, who only arrived home three days ago, will make his report to the Council on June 22nd, and, with its permission, it will be issued to the members as soon after as possible.

It may be of value to recall that at the two previous Imperial Conferences the question of industrial standardisation was reviewed.

The Imperial Conference of 1926 called attention to the advantages which might accrue to Empire trade from an extension of standardisation of industrial products, and urged the several Governments to take steps to promote co-operation within the Empire.

The Imperial Conference of 1930 set up a special Conference on Standardisation (Fundamental and Industrial). The Industrial Conference urged:—(1) Formation of one Central Standardising Body in each constituent part of the British Commonwealth; (2) standardisation to include specifications for materials, apparatus, machinery, codes of practice, and simplification of types and sizes; adoption of a standardisation mark; (3) support from the Government with establishment of officer or department to stimulate standardisation; (4) establishment of index of specifications in use by large buyers; (5) continuous consultation between the central standards bodies with a view to specifications and codes being as uniform as possible.

This Institution, with the cordial assistance of the Board

of Trade, has complied to a very large extent with the recommendations of the Imperial Conference of 1930. During the past year or two a large number of draft specifications have been received from Australia, and a few from Canada, and a draft of every proposed British Standard Specification has been sent overseas. This interchange has already proved very useful, and an exchange of these drafts at an earlier stage in their progress is likely to take place.

Whilst the British Standards Institution necessarily has a deep interest in any question relating to the unification of standards within the Empire, it has also for many years taken an active part in certain directions in the unification of international standards, as well as watching very carefully the development of national standards in different parts of the world.

International agreement was reached last year in regard to a standard reference temperature for linear measurements, the British Government delegate to the International Bureau of Weights and Measures having consulted industry generally through the *ægis* of the B.S.I. The change involved is only of interest to those manufacturers who are working to the very highest degree of precision and maintaining the most accurate standards of length.

Whilst the Institution is not a member of the International Standards Association, it participates when the responsible organisation in the industry concerned desires to do so. During recent times there have been several cases of such participation; for example, on the subjects of ball bearings, pipe fittings, and flow of liquids.

The Institution maintains close contact with numerous other international bodies and its various Committees act in co-operation with the National Committees of these bodies wherever questions of standardisation are involved.

The general work has proceeded satisfactorily, and the reports by the Chairmen of the Divisional Councils indicate satisfactory progress.

Following the appeal made by Mr. Ll. B. Atkinson, Chairman of Finance Committee, at the last annual meeting, it is gratifying to be able to state that the membership of the Institution has grown satisfactorily, there being an increase of some 23 per cent.

The total number of specifications issued is forty-nine—only three less than in the previous year—but the number in preparation is higher than ever before on account of the work of the new sections.

The Institution continues to take an active part in the work of the Interdepartmental Government Committee.

The instructions to the Government Sub-Committees are to adopt wherever possible British Standard Specifications. Where no such specifications exist, to adopt the appropriate trade specification if such is available. Where such a trade specification is not applicable to Government purposes, a Government Committee draws up an interdepartmental specification, and the draft specification is sent to the Institution for circulation to other large users and industry generally for comment.

It will be generally agreed that this is a far-sighted policy and one leading to economy of expenditure as well as being directly of assistance to industry.

GOVERNMENT SUPPORT.

The cordial support of H.M. Government is reflected, not only in the continued grant, but also in the very active interest taken by the President of the Board of Trade and his Department. Mr. Percy Ashley, who has represented the Board for many years on the Council of the Institution, has resigned to take up his new duties, and the thanks of the Institution are due to him for the very great services he has rendered. His successor, Mr. Browett, has already shown his appreciation of the importance of the work of industrial standardisation.

All the Government Departments assist the Committees in the preparation of British Standard Specifications.

The Department of Scientific and Industrial Research has carried out, as in former years, either directly or through one or other of the Research Associations formed under its *ægis*, a large amount of investigation work for the assistance of our Committees. This represents a substantial technical contribution to industry, and the cordial help of the Secretary and the staff of the Department is greatly appreciated by the numerous Committees.

After the meeting a luncheon was held at the Royal Automobile Club, when the principal guest was the Right Hon. Walter Runciman (President of the Board of Trade), and at which some indication was given of the results likely to follow from Mr. le Maistre's tour. Mr. Runciman, proposing "The British Standards Institution," said that it was for the good of the world, as well as for the British Empire, that standardisation should proceed apace, because no form of waste in science or engineering could be justified. Speaking of national economy, Mr. Runciman said that one of the items of national expenditure which was not grudged was the grant made to the British Standards Institution, and he wished that the financial times were more propitious and that the Government could add to that grant and thus help the activities of the Institution to a still greater extent. Gladly, however, as the Government supported the work of the Institution, its view was that industry should look after itself. There was no doubt that industry was better and safer, more enterprising and truthful, when it was in the hands of industrialists, and the less the Government had to do with controlling its destinies the better it would be for industry and commerce as a whole.

Speaking with regard to Imperial co-operation, Mr. Runciman recalled that the Imperial Conference o 1930 set up a special Conference on Standardisation. In the view of the Government one of the best ways to foster Imperial trade was by making our standards interchangeable, by our specifications being as nearly as possible uniform, and by carrying through complete co-operation of organisation as well as scientific application.

The toast was supported by Mr. G. H. Ferguson (High Commissioner for Canada).

Mr. Maurice F. G. Wilson said the presence of Mr. Runciman was direct evidence of the association and help of the Government in the work it was doing. The Institution had recently received a Royal Charter and the scope of its work had been extended. The aim now was that specifications developed in this country should be exchanged with the Dominions in order that, as far as possible, general concurrence might be obtained so that the specifications would provide for the conditions obtaining in the Dominions.

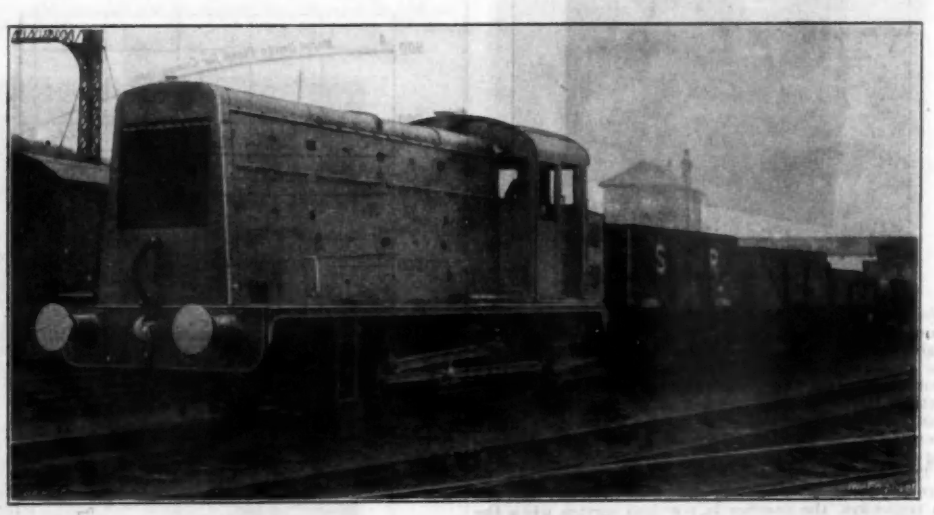
Mr. C. le Maistre, speaking of his tour to Australia, New Zealand, and Canada, said it was made apparent to him in Australia that everyone without exception was anxious to do all they possibly could to assist the Mother Country to regain something of her former prosperity and that uniformity of specifications would be a considerable help. The Standards Association of Australia was an extremely strong body and, up to recently, had received a very much larger grant from the Government than we had ever dreamed of asking from the Government in this country. In New Zealand the conditions were different, but quite recently the New Zealand Government had appointed a Committee to explore the possibilities. Mr. Luke—an engineer—was the Chairman of the new Standards Committee which had just been instituted as a direct result of the conferences he himself was privileged to have in New Zealand, and the Prime Minister of New Zealand had shown an extraordinarily wide grasp, not only of standard specifications, but of the potential possibilities of the increase of Empire trade through agreement on such specifications. In Canada he also found the greatest desire to encourage trade through the medium of standard specifications. There was a most encouraging and sympathetic attitude to the proposals he had laid before the authorities and industrial people which convinced him that there would be the fullest co-operation in this matter on the part of Canada in the near future. Wherever he had gone in the Dominions during his tour he had found that once the idea of these national commercial standardised specifications had been fully understood the idea was received with the greatest sympathy.

An Oil-Electric Shunting Locomotive.

THE first trials of a new Armstrong-Whitworth 40-ton six-coupled oil-electric shunting locomotive were made last Friday, June 10th, in the presence of Mr. H. N. Gresley, the Chief Mechanical Engineer of the London and North-Eastern Railway Company. The locomotive was attached to a 550-ton goods train, which it started satisfactorily on a gradient of 1 in 200. It was then made to break up this train in the normal manner and performed the task very satisfactorily. A valuable feature shown by the test was the ease with which the locomotive could be handled in coupling up to a train. Mr. Gresley found that it could be moved a few inches at a time with certainty and could be brought into position without shock. When required, a very rapid acceleration was also available.

The locomotive is controlled by one hand lever, which is duplicated on each side of the cab. If full acceleration is required the driver has merely to turn his handle fully round. The value of the even turning moment of the electric transmission was demonstrated by the fact that at no time did the wheels slip, in spite of the fact that the maximum tractive effort of 24,000 lb. was frequently obtained. The locomotive is equipped with a standard Armstrong-Sulzer six-cylinder four-stroke oil engine coupled to a generator which supplies power to a single electric motor coupled by jack shaft and connecting-rods to the six driving wheels. The engine is stopped and started elect ically and only runs when power is required.

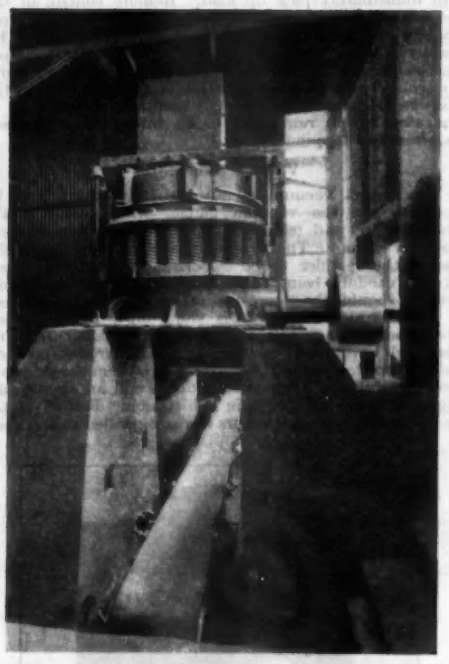
As a result of this preliminary test the London and North-Eastern Railway Company has agreed to carry out extended trials in one of its goods yards to investigate the suitability for service and reliability of the locomotive.



OIL-ELECTRIC SHUNTING LOCOMOTIVE

Quarrying Plant.

THE quarries of the Cumberland Granite Company, Ltd., are situated on the main Cockermouth–Keswick road in the centre of Cumberland, close to the shores of Lake Bassenthwaite and overlooked by Skiddaw. The company was founded in 1919, and the original crushing equipment was installed by Robert Broadbent and Sons, Ltd., of Stalybridge, power for driving the various items of machinery being supplied from suction gas engines. This equipment was capable of dealing with an annual output of 70,000 tons, but during 1931, owing to steadily increasing business, extensions to the plant became necessary. It was therefore decided to add new crushing, handling, and screening plant, with a capacity of 500 tons per day, and, further, to install an electrical power station, so that full advantage might be taken of electrical drive for the new machinery. The contract for the new crushing, handling, and screening plant was awarded to Robert Broadbent and Son, Ltd., of Stalybridge, and that for the electrical plant and equipment to the General Electric



SYMONS CONE CRUSHER

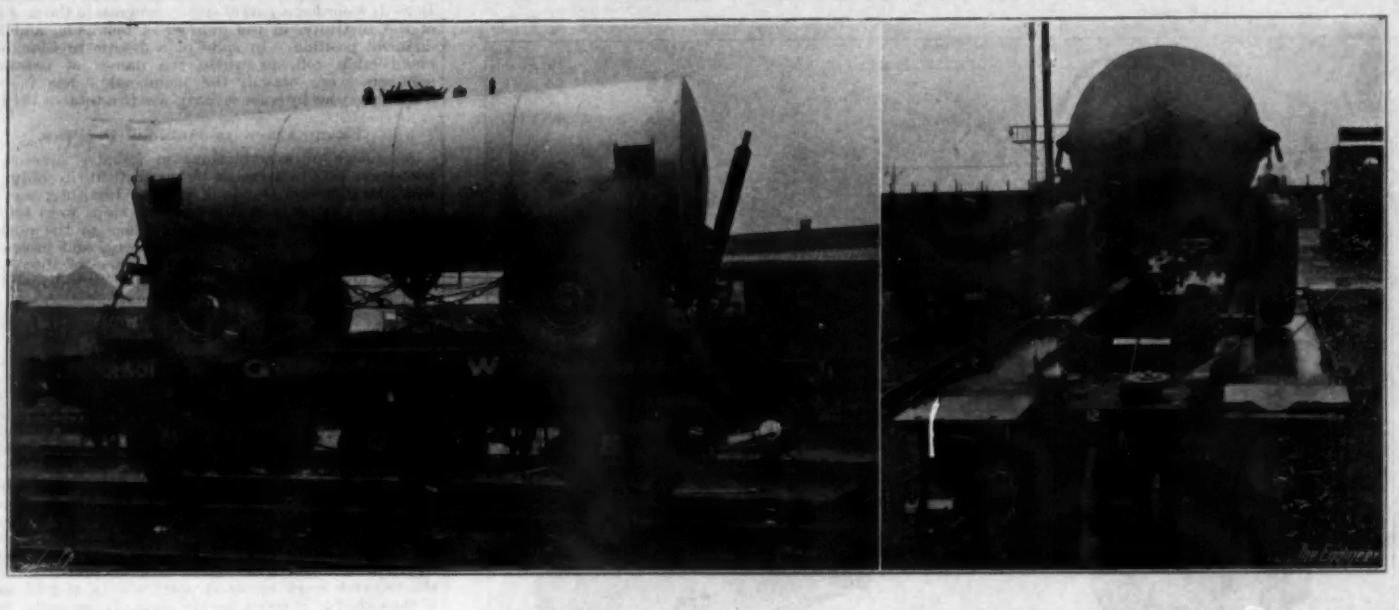
Company, Ltd., of London and Birmingham. Petters, Ltd., of Yeovil, secured the contract for the oil engine.

The original crushing plant, which is fed by a brake-controlled incline of 1 in 3, will, in general, operate independently of the new plant, but a connecting conveyor has been arranged so that both can run in conjunction when necessary. The new plant is of Broadbent's design and manufacture, with the exception of a 36in. Symons cone crusher, for the conversion into chippings of sizes not in demand at the moment, and three Sherwen (double-deck) vibratory screens, which were manufactured by the Fraser and Chalmers Engineering Works of the General Electric Company, Ltd.

The main crushing units consist of a 30in. by 16in. breaker feeding two 24in. by 12in. machines. The broken granite then passes along a conveyor to what is termed a "by-pass" screen, and the method of handling reveals considerable ingenuity. All under ⅜in. is dropped by a chute on to a 24in. belt conveyor *en route* for final screening and bunkers. All over ⅜in. and under 1¼in. or over 1¼in. and under 2½in. is passed to a separate 18in. belt conveyor until the quantity of graded sizes is sufficient to meet the existing demand. As soon as the demand for macadam or ballast is met, the "by-pass" operates and the largest sizes are reduced to ⅜in. and under in the Symons cone crusher, which is illustrated by the accompanying engraving. The rejects from the "by-pass" screen, such as any granite pieces too large for the cone crusher, are conveyed to the hopper feeding the old plant. The bunkers, over which the vibratory and macadam screens operate, hold 500 tons.

The chief feature of the new crushing plant is its great flexibility, which enables the immediate requirement of any particular size or sizes to be met. The costly operation of stocking and consequent handling of products not in immediate demand is thus entirely avoided. Hence from quarry face to road or rail, production costs are kept at an absolute minimum.

G.W.R. TRUCKS FOR MILK TANK TRAILERS



Trucks for Milk Tank Trailers.

To meet the requirements of the milk trade whereby milk in bulk can be conveyed by road from a collecting depôt to the railway, thence by rail to a distant station, and afterwards by road to a receiving depôt, special trucks, illustrated above, have been designed and built by the Great Western Railway at Swindon for carrying 2000-gallon milk tank trailers built by Messrs. Dyson, of Liverpool, for the United Dairies Company.

Novel features have been introduced into the truck and the trailer, whereby the weight is entirely removed from the pneumatic tires when the trailer is loaded in position on the truck. Cast steel drums, capable of carrying the weight of the loaded vehicle, are formed on the insides of the wheels of the trailer. The truck is fitted with elevated tracks, the centres of which coincide with the centres of the drums on the trailer and act as carrying and guiding elements. The centre portions of the carrying tracks are level for a length of 11ft. 6in., and slope down 2¼in. in 2ft. at the ends. The vertical guiding faces of the tracks are 4ft. 4in. apart, parallel for a length of 15ft. 6in., and flared at each end, reducing the width to 3ft. 4in. for the purpose of serving as a centralising device when the trailer is not in perfect alignment with the truck when being towed on. The floor of the truck is composed of steel plate in the centre, the ends being of timber 3in. thick for the first 2ft. 6in., and tapering down to ¼in. thick in the next 2ft. For towing on and off by means of a wire rope, one swivelling and two fixed pulleys are provided at each end, between the tracks. The tractor is thus enabled to pull from the sides or ends, whichever direction is convenient. A small platform is fitted over each buffer guide with one hinged flap at each end and cross cornered, for bridging the gap between another truck of this type, or the loading bank. When loading or unloading from a bank a loose loading plate is provided to fix on to the platform which carries no hinged flap. The method of loading is as follows :—

The truck is placed at the end of the loading bank and the trailer brought up as near to the truck as possible. The wire rope is passed round the most convenient pulleys and one thimbled end secured to the tractor and the other to the trailer in readiness for the towing operation. After the leading trailer wheels have travelled 2ft. 6in. they begin to run down the floor decline and directly afterwards the wheel drums come into contact with the inclined portion of the carrying track. By the time the trailer has travelled 4ft. 6in., the leading running wheels have been relieved and the weight transferred to the drums, owing to the 2¼in. rise and fall in track and floor levels respectively. The process is repeated when the trailing wheels pass on to the truck. To steady the truck and prevent movement while loading or unloading operations are taking place, adjustable rail clips and chains are attached to each headstock. Binding chains and wheel bars are fitted to keep the trailer in position during transit. The vehicle is fitted with vacuum brake and through steam pipe for running in fast train services. The trucks proved to be very successful when loading and unloading tests were recently carried out.

The following are the principal dimensions :—

Length over headstocks	20ft. 6in.
Length over buffers	23ft. 11in.
Width over headstocks..	8ft. 6in.
Total wheel base	13ft.
Load to carry..	14 tons
Tare	11 tons 11 cwt.

A New Heavy Oil-Engined Six-Wheeler Lorry.

THE latest production of Armstrong-Saurer Commercial Vehicles, Ltd., the heavy oil-engined Dominant six-wheeler commercial vehicle, designed and built to carry a load of 11/12 tons, recently underwent its first road tests at Newcastle. These tests included hill climbing under full load, speed and manœuvrability under bad conditions. The unit is an engine with a power output of 90 H.P. at 2000 r.p.m., using heavy oil fuel which, by reason of its lowness of cost and freedom from taxation, permits a considerable economy in running to be effected.

An interesting feature is the rear axle, which is illustrated by the accompanying engraving. The main axle housing is a steel pressing and encloses a main differential

REAR AXLE OF OIL-ENGINED SIX-WHEELER LORRY

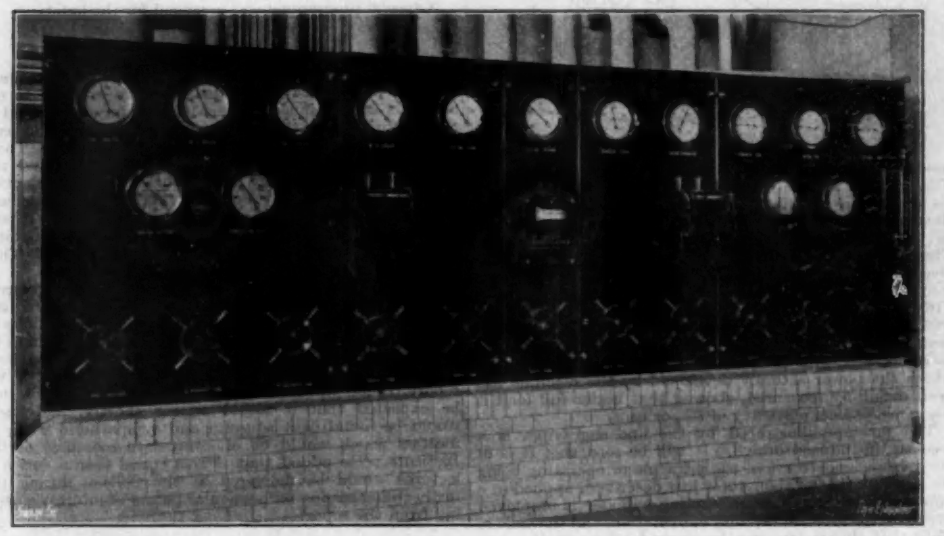
and a bevel gear, and the drive is transmitted to all the four rear wheels. There are three differentials—the main differential, and one in each of the balancing beams in between the fore and aft shafts. These latter are enclosed in the balancing members which are also of a pressed steel construction. All the gears employed for driving the four rear wheels are of the bevel gear type. The wheels are carried by steel shafts, running on ball bearings in separate housings attached to each end of the balancing beams. A casing is bolted to the spring seatings on each side, which projects to a width almost equal to the width of the chassis. These casings provide a support for the balancing beams, which are pivoted on roller bearings.

The rear springs are composed of five leaves only. The leaves are 1¾in. thick and the length of the eye plate is 9ft. 5in. These springs transmit the drive and also the torque and are flat under full load.

Six wheel brakes are fitted, and are operated through the foot pedal by compressed air. The compressor is driven from the gear-box, and the air is stored in a cylinder attached to the chassis frame member. Further, there is a hand brake, mechanically operated, which acts on the transmission. This brake is used for emergency and parking.

Instruments for a Heating Installation.

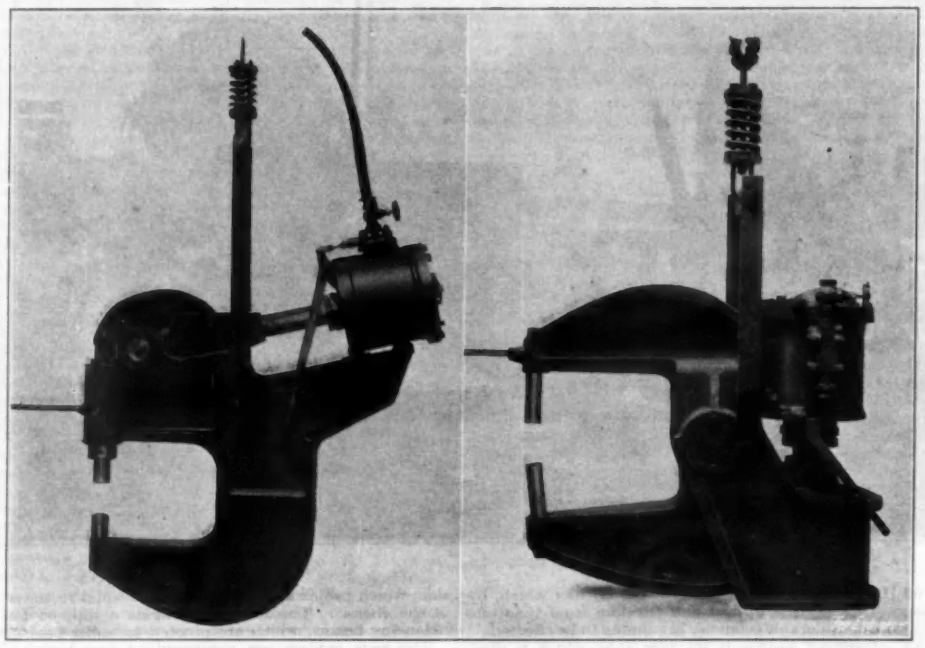
THE photograph reproduced in the accompanying illustration shows the instrument panel of Unilever House, for which Negretti and Zambra, of Holborn-viaduct, supplied a number of flush-mounted instruments with chromium-plated bezels. In all, there are eleven thermometers of the mercury-in-steel type, in which the expansion of the mercury in the bulb actuates the pointer through a coiled Bourdon tube. The connecting tubing serving the thermometers is of various lengths, according to the situation of the bulb within the building. The shortest is 14ft. and the longest 120ft. For the longer connecting tubes special compensating devices are inserted so that the capillary tubing can pass through spaces at various temperatures without any effect upon the accuracy of the reading. The instruments indicate the various boiler flow and return temperatures, the temperature in the air washers and the outside air temperature. The panel also shows altitude, and gauges are fitted for water, oil, and air pressures. A multi-point electrical distance thermometer indicates the air temperature in various parts of the building and is operated by a mains unit, which dispenses with the need for accumulators. The instruments were all supplied to the order of Messrs. Young, Austen and Young. Negretti and Zambra are also supplying instruments for the heating plants of the new head office of Barclays Bank in Lombard-street, and for the new Shell-Mex offices in the Strand.



INSTRUMENT PANEL OF THE HEATING INSTALLATION, UNILEVER HOUSE

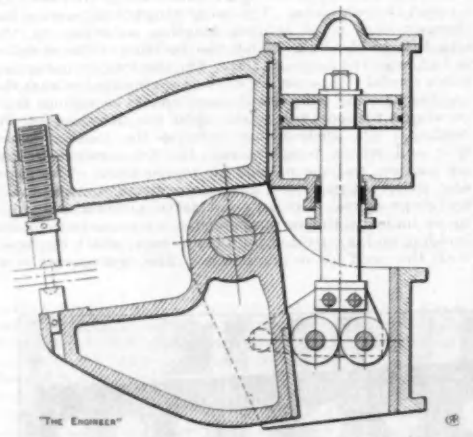
PNEUMATIC RIVETERS FOR RUSSIA

FIELDING AND PLATT, LTD., GLOUCESTER, ENGINEERS



Pneumatic Riveters for Russia.

A NUMBER of pneumatic riveters of various sizes have recently been completed by Fielding and Platt, Ltd., of Gloucester, for export to Russia. They are of the squeeze type, operated by a pneumatic cylinder. The machine illustrated on the left above operates on a principle first applied by the firm in 1898, and since improved. The piston actuates a hinged lever by means of balanced rollers working on an inclined plane. The contour of the roller path is so arranged that during the earlier part of the working stroke the power on the snap increases approximately in proportion to the resistance offered by the rivet, the full power only being exerted when forming and finishing the rivet head. The full power of the riveter remains approximately constant for a definite portion of the latter end of the stroke, thus allowing for variations in the lengths of the rivets handled and in the thickness of the work. The adjusting screw for the snap need only be



used if there are radical changes in the nature of the work. The air used for the working stroke serves afterwards by its expansion to effect the return stroke. The riveter illustrated has a 24in. by 21in. gap, exerts a pressure of 80 tons, and is suitable for driving 1¼in. rivets. The specified speed of the machine is 450 1¼in. diameter rivets an hour through 3in. total thickness. We are informed by the makers that during the official tests 116 rivets were closed in ten minutes, equal to a rate of 696 rivets per hour. Subsequently the machine demonstrated that it was capable of dealing with 1¼in. rivets satisfactorily. The makers state that careful tests during which the power actually developed by the machine has been definitely measured, showed that under full load it has a mechanical efficiency of 80 per cent.

The machine illustrated by the line engraving, is a recently introduced design. It will be seen that it is of very simple construction, the principle of operating being the same as that of the riveter just described, applied in a different manner. A double-acting cylinder is employed to ensure the greatest rapidity of operation, and the makers state that this riveter can be worked more rapidly than the other type. The other tone engraving illustrates a 50 tons riveter with a 20in. gap for 1in. rivets, hot. That the machine has ample power may be gathered from the results of the official tests. The makers inform us that the riveter closed satisfactorily a number of rivets of the maximum size, utilising an air pressure of 85 lb. per square inch, although the specified pressure is 100 lb. per square inch.

Institute of British Foundrymen.

ANNUAL CONFERENCE AT NEWCASTLE.

No. I.

THE Twenty-ninth Annual Meeting and Conference of the Institute of British Foundrymen was held at Newcastle-on-Tyne from Wednesday to Friday, June 8th to 10th, under the presidency of Mr. Victor Stobie, M.I.E.E., of the Stobie Steel Company. It was Mr. Stobie who founded, in 1905, the Sheffield Annealing Works, where large producer-gas-fired annealing furnaces, patented by him, for the treatment of long bars of tool steel and alloy steels, heat-treated material from most of the steel works in the Sheffield district. He sold his interests in 1912. The Stobie Steel Company was established in Sheffield in 1909, and new works were started in 1913 at Dunston-on-Tyne. Mr. Stobie is credited with having produced the first British high-frequency melting furnace.

The Conference programme was very attractive, and the Institute is continuing its practice of exchanging technical papers with kindred associations abroad. Of the nine technical papers presented at this Conference, one was from France, dealing with moulding and founding practice, and another, from America, dealt with high-test cast iron developments in that country.

The programme included, of course, a number of social functions, and, in addition, parties visited the works of the North-Eastern Marine Engineering Company, Ltd., Wallsend-on-Tyne; A. Reyrolle and Co., Ltd., Hebburn-on-Tyne; Sir W. G. Armstrong-Whitworth and Co. (Iron Founders), Ltd., Gateshead-on-Tyne; the Priestman Collieries, Ltd., Norwood Coke Ovens and By-products Works, Teams; the Consett Iron Company, Ltd., Consett; Armstrong-Saurer Commercial Vehicles, Ltd., Scotswood Works, Newcastle-on-Tyne; and Smith, Patterson and Co., Ltd., Blaydon-on-Tyne.

A special programme was arranged for the ladies.

A WELCOME TO NEWCASTLE.

Representatives of the civic, industrial, and educational interests of Newcastle extended a hearty welcome to the members and their ladies when the Conference opened in the Lecture Hall of the Literary and Philosophical Society, Newcastle, on Wednesday morning, June 8th. These representatives were the Deputy Lord Mayor and the Sheriff of Newcastle; Sir Arthur Sutherland (representing Lord Joicey, J.P., the President of the Newcastle and Gateshead Incorporated Chamber of Commerce); and Sir William Marris, K.C.S.I., K.C.I.E., B.A., D.Litt., Principal of Armstrong College, Newcastle, and Vice-Chancellor of the University of Durham.

Sir William Marris, in the course of his remarks, referred to the work done by Armstrong College, at the request of the Government, in connection with the industrial survey of the heavy industries, the results of which he hoped would be made public shortly. There had been regrettable delay in the printing and publishing of the report, which was in the hands of the Government, but he expected that it would appear shortly, and there would be found in it a useful and sympathetic study of matters which would be of interest to members of the Institute. He added that it was hoped that a series of lectures would be delivered at the College during the forthcoming session on particular points of interest emerging from the report.

THE OLIVER STUBBS MEDAL.

The Deputy Lord Mayor then presented the Gold Medal awarded each year by the Institute for work advancing the technical knowledge of the industry. It bears the name of the Institute's Past-president, the late Mr. Oliver Stubbs. On this occasion it was presented to Mr. J. E. Hurst (of the Sheepbridge Stokes Centrifugal Castings Company, Ltd.) for his outstanding contributions to the metallurgy of cast iron, particularly in the form of new alloys, so widening the use of cast iron.

ANNUAL REPORT.

The annual report of the General Council for the session 1930–31 recorded a year of steady progress in the usefulness of the Institute, in the number of members, and in its financial position. In spite of a drastic revision of the membership roll, in which the names of non-paying members were erased, the membership has increased during the year by a net seventy-five to a total of 1919.

EXAMINATIONS IN FOUNDRY PRACTICE.

A scheme of examinations in foundry practice and patternmaking, undertaken by the Institute in conjunction with the City and Guilds of London Institute, was completed last summer, and immediate steps were taken to bring the syllabuses and examinations to the notice of foundry proprietors, technical colleges, and prospective students. The syllabus implies a course of three years, so that another two years will elapse before many new students will be able to sit for the examinations.

REPORT OF TECHNICAL COMMITTEE.

In October, 1930, the Technical Committee of the Institute was formed to deal with technical questions submitted to the Institute, and to form a connecting link between the Institute and other technical bodies with which it co-operates. It has five sub-committees dealing respectively with cast iron, non-ferrous metals, steel, malleable iron, and sands and refractories.

At the beginning the Committee confined itself mainly to exploratory work, with the object of examining, analysing, tabulating by special card system and correlating existing knowledge, and pointing out the directions in which further information could usefully be sought by research or otherwise. If the General Council considered the research work reported upon was to the advantage of the industry, it could then be handed over to the British Cast Iron Research Association to continue. A number of sub-committees made reports to the Technical Committee, and those reports are summarised in the general report.

ELECTION OF OFFICERS.

The meeting elected the following to serve in the capacities indicated during the ensuing year:—President, Mr. V. Stobie (Newcastle-on-Tyne); Senior Vice-president, Mr. C. E. Williams (Cardiff); Junior Vice-president, Mr. R. W. Stubbs (Lancashire Branch).

PRESIDENTIAL ADDRESS.

Mr. Stobie, in his address, made an appeal to ironfounders as a whole, for a more exhaustive scientific investigation of their metal, instead of leaving investigation work to the few. Cast iron, he said, is different from most other metals, in that it can only be used in the form of a casting, so that the ironfounder does not have to compete, as do the founders of brass and steel, with a competition producing a more or less similar material in the wrought form. This lack of a competition has, perhaps, not helped the ironfounder to put forward his greatest efforts.

It is within the reach of all ironfoundrymen, he urged, to have a fair understanding of the basic principles of the metallurgy of cast iron by an extent of study well in proportion with the resulting advantages. To a foundryman who desired to acquire as quickly as possible a working understanding of ferrous metals, he recommended the study of physics to greater extent than chemistry, for the principles governing successful metal production and founding involve more physics than chemistry. The metallurgist's principal section of chemistry he called, for the sake of distinction, "thermal chemistry." The chemistry of the laboratory he referred to as "cold chemistry." Thermal chemistry, he continued, might be studied by first acquiring a knowledge of the technics of combustion. If the student had only time to devote himself to a single study—though one could not possibly commend such limitation—the acquiring of a thorough knowledge of the physics and chemistry of combustion would be the most remunerative study he could make. With such knowledge he would appreciate more than he might have thought possible a considerable number of happenings.

The way of a systematised physical study of cast iron was shown in 1885 by Professor T. Turner, of Birmingham University, who made a comprehensive series of pure cast irons to which he added increasing percentages of silicon. His research had shown, for the first time, the effects of varying the element. One could have hoped that such a fruitful investigation would have encouraged ironfounders to further the quest for all similar basic information. Private interests had pursued certain directions of work; in some cases with great recompense to themselves. Thorough research had been done in all the usual elements in the case of all other industrial metals.

If the cast iron industry possessed reasonably tabulated figures showing, for iron made under given conditions, the effect of variation of the percentage of each of its normal constituents, and the effect of varying heat treatments on those irons, we could picture an industry still more potent to help the engineer and, through him, the world.

Considerable essential investigation had yet to be done on the influence of blast-furnace and cupola operation on the ultimate quality of cast iron of given composition. Could a uniform product be ensured at all times by skilful foundry control, notwithstanding any previous history of the iron, so long as its composition was correct? If he dared answer his own question he would probably answer that in the affirmative. He merely asked his hearers, however, to picture what it really portended if a skilful metallurgist had, with to-day's knowledge and facilities, and with technical discipline in the foundry, the wherewithal invariably, or almost invariably, to produce good casting metal notwithstanding inconsistency of quality in his raw material.

The President warned the ironfounder, however, when experimenting in new directions, not to be unduly controlled by supposed axioms from text-books if they did not coincide with the results of his well-conducted experi-

ments. It had happened that statements based on little evidence had been copied from text-book to text-book until they had assumed the aspect of accepted facts.

A parting suggestion to the intending investigator was to realise early that a metallurgist should not attempt mathematical deductions from his discoveries. He must not conclude, for example, that if a 1 per cent. manganese steel was tough and a 15 per cent. manganese steel was tougher, a 5 per cent. one would be of intermediate toughness; nor that because iron was made non-magnetic by adding 30 per cent. of nickel it followed that greater additions could not make it again magnetic. He must not deduce that because wrought iron increased its electrical and thermal resistivity as it approached its melting point, cast iron did the same. Such presumptions would lead his metallurgy to disaster.

The reading and discussion of papers was then proceeded with.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Trade Situation.

INDUSTRIAL activity in the heavy trades of the Midlands and Staffordshire shows little change in volume on the week, but with a brightening outlook the general tone is improving, and expectations of an advance in consumptive demand are more prevalent. Sales of iron and steel to the manufacturing trades are about maintained at recent levels, as is the output from district finishing works. Quiet conditions rule on the Birmingham Iron and Steel Exchange. It is too early to expect any marked reaction from the new situation which is in course of development. The new import duties upon pig iron, stampings, and pressings, castings, iron and steel ingots, and spring steel are welcomed in most quarters, though admittedly deplored in others. There is general satisfaction with the decision of the Committee regarding certain classes of wrought iron bars, and rolled strip, while the proposed extension of the existing duties upon iron and steel for a further limited period is according to anticipations. It was thought the Committee would hardly be in a position to put into practice new and permanent protective proposals at the expiration of the first three months. It is quite evident, however, exactly how the Committee feels regarding the matter of adequate protection for iron and steel, and it is up to the industries to do their share with as much despatch as possible. It may be well to remind readers in other areas that the Midland district took concerted action months ago. A committee representing the various branches of the iron and steel industry from Staffordshire and Yorkshire and Lancashire has been in consultation on different aspects of reorganisation, and has satisfied itself incidentally of the ability of the steel mills at home to supply the half-products which re-rollers have been deriving from abroad. The action of billet makers is a move to be commended, and, where possible, followed. A direct attack upon the foreigner by the industry itself in the shape of lower prices is almost bound to meet with some success. Just at the moment the requirements of users of iron and steel are not large, and the stocks at their disposal are adequate for the time being, so that immediate results are not looked for. However, there is a good deal more hope for the future than there was at the beginning of the quarter, and the Midsummer quarterly meeting of the Midland iron trade in July may possibly mark the beginning of a definite progressive trade movement.

The New Billet Prices.

Steelmasters have made a decided move towards wresting, if possible, from the foreigner the appreciable business he has done of late with re-rollers in Staffordshire and elsewhere. Shortly before Sir George May made his statement on behalf of the Advisory Committee, the associated English billet makers announced a revision of their prices, which had for a long time been based on £5 7s. 6d. for ordinary soft re-rolling qualities. For 500-ton lots and over for prompt rolling the price is now £4 17s. 6d.; 250–500 tons, £5; 100–250 tons, £5 5s. Steelmasters evidently concluded that the time was ripe for a contest with overseas makers. Since the import duty was raised to 33⅓ an appreciable quantity of foreign billets has been bought by re-rollers in this country, the gap between British and Continental prices being about 18s. per ton. The amount of business recently done with the foreigner is considered to be sufficient to make a substantial difference to production costs if it can be secured for home producers, for economy lies in heavy outputs. The steelmasters' offer to supply billets of 500-ton lots and upwards at £4 17s. 6d., and other tonnages on a graduated scale is, however, subject to the condition that the specifications are to be for prompt rolling, delivery being to one destination in the Birmingham district. Moreover, the offer is made to consumers only, and it does not apply to contracts. Consumers in this area, as I recently pointed out, have all the billets they want for the present. It was to be expected therefore that at the moment there would be little or no response to the lowering of prices for bulk sales. In other branches of the steel trade there is no movement from the position occupied a week ago. Demand for finished steel is on a small scale. Selling prices of controlled material are maintained at the level fixed by the Association, and there has been no alteration in quotations for other classes of finished material.

Pig Iron.

Blast-furnacemen in Northamptonshire are glad to know that foreign pig iron is to be subject to a duty, as it will assist them to sell more of their own production in northern markets, where they are not subject to price control like they are when selling in the Midlands. They would, of course, prefer to dispose of the whole of their output in this area at the higher price, but since they are not able to do so they cultivate, to the extent of their stocks, other less remunerative markets. Derbyshire smelters are practically unaffected by the change, practically, if not the whole of their production being disposed of to district consumers. Business this week has been much as it was last. The position is clearly shown by the facts that there are still sixty-nine furnaces in blast the country over, the same as there were at the opening of last month, for though three furnaces have been put into operation, three were blown out during the month. It is of interest to note that the production of pig iron in May amounted to 315,300 tons, compared with 316,900 tons in April, and 346,500 tons in May, 1931. Production included 75,400 tons of hematite, 128,000 tons of basic, 92,600 tons of foundry, and 11,300 tons of forge iron. Raw iron values show no change. Derbyshire No. 3 foundry is £3 6s. per ton, delivered to Black Country stations, forge is £3 1s., while Northamptonshire brands are £3 2s. 6d. and £2 17s. 6d. respectively.

Finished Iron.

The makers of finished iron in Staffordshire manage to keep plant employed at recent levels, but demand remains poor for all classes of puddled iron. Orders come along in the best bar branch day by day, but there is no collection of business on the books of local firms, and production is accordingly spasmodic. Makers of marked bars uphold their prices, despite the fact that there has been less work available than of late. They do not incline to the opinion that business would be better if values were lower nor does there seem anything to justify such an assumption. This class of material stands almost alone for certain engineering purposes, and where there is business going it finds its way to the Staffordshire mills. The price of £12 per ton is considered to be quite reasonable, taking all circumstances into account. Crown bar prices vary as widely as during the past few months. While this class of bar is to be had at £9 from one source, it would be unprocurable from another at under £9 15s. Granted the quality would not be the same, but they are all designated as Crown bars. Nut and bolt iron sells but slowly at £8 and fencing bars at £7 15s. Wrought iron gas tube strip is firm at £10 10s. upwards, and mills remain fairly well engaged.

Galvanised Sheets.

The position of the galvanised sheet trade shows little change from the last few weeks, and sales have been made as low as £9 5s. for 24 gauge, though there are makers who would not accept this figure. Many mills quote £9 7s. 6d., and consider this the minimum. Recent overseas inquiries have not as yet developed into actual orders. Exports of galvanised sheets last month were to the value of £260,132, as compared with £255,076 in May last year. For the year to date also the figures of business done abroad show improvement on the corresponding period last year, the respective figures being £1,502,503 and £1,327,465.

Trade Returns.

The trade returns for the month of May have been carefully perused by Midland industrialists, but they hesitate to express an opinion upon them. They will take careful note of the next few returns, however, in the hope and expectation that in so far as they affect Midland industries the figures will show trade progress. They did not fail to observe that the total quantity of iron and steel imported during May amounted to only 144,013 tons, of the value of £677,755, as compared with a tonnage of 227,757, valued at £1,554,119 in the corresponding month last year. Imports of iron and steel for the year to date amount to 841,414 tons, as compared with 1,030,443 tons in the same period last year. Midland manufacturers note that, as compared with May last year, the value of British manufactures exported declined, the relative figures being £23,158,164 and £26,000,465. This was largely due, however, to the fact that the value of ships completed for foreign owners was only £308,807 last month, against £2,452,852 in May last year. Imports of manufactured goods dropped by no less than £9,415,607, the only exceptions to the general decline being a small increase of £34,182 under the head of vehicles. Raw materials registered a net decrease of £891,681.

Elegant Wrought Iron Gates.

Excellent examples of Midland workmanship are the wrought iron entrance gates for the Parliament Buildings of Northern Ireland, which have been constructed by Messrs. Bayliss, Jones and Bayliss at the Victoria Works, Wolverhampton, and which have been dispatched and erected within the last few days. They are being finished with gold and silver leaf, and when completed, it is stated, will form one of the finest sets of gates in the Empire. The weight of the gates and railings supplied is 42 tons. There are two gates—one at the Processional-road main entrance and the other at the Massey-avenue entrance. The cast iron and bronze enrichments of the gates are massive, and the general ornamentation is in the Grecian style, to blend with the classical lines of the building. The gates were designed by Messrs. Briggs and Thornely, architects, of Liverpool.

Northamptonshire Mills to be Opened.

Much satisfaction is expressed in Northamptonshire that the Burton Latimer Mills, near Kettering, which have not been in use for five years, are to be opened again. They have been taken over by the British and African Cereal Company as their first English factory for the manufacture of ready-to-eat foods. The company, which owns fifteen colonial factories, is reported to have decided to produce in England on account of the new import duties; 200 people, I am given to understand, are to be employed, and wheat from the local farms is to be used in the manufacture of the firm's products.

Birmingham Firm's Reservoir Tender.

Newport (Monmouthshire) Waterworks Committee this week recommended the Town Council to accept the tender of Percy Trentham and Co., Ltd., Birmingham, for the construction of an impounding reservoir in connection with the Corporation's waterworks scheme at Talybont, Breconshire. It is understood that the tender of just below £320,000 was the lowest received. Twenty-one noted contractors competed for the work.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Expanding Markets for Textile Machinery.

SHIPMENTS of British textile machinery continue to improve, and the exports during May, according to the Board of Trade returns published this week, more than maintained the average of the preceding four months of the year. The total exports during the month reached 6261 tons, valued at £511,391, and included 4277 tons of spinning and twisting machinery, valued at £357,325, and 1507 tons of weaving machinery, valued at £104,346. The May figures compare with 5363 tons and £495,492 in the corresponding month of last year, and 8479 tons and £830,927 in May, 1930. Altogether, in the completed five months of the present year, the exports have amounted to 27,835 tons and £2,404,600, against 21,835 tons and £2,198,037 in 1931. Shipments to Russia during the month under review were negligible, and compared with a year ago there were declines also in the takings of Germany, France, China, the United States, and Australia. A rather substantial increase in the trade with India, however, helped to counterbalance the shortcomings in other directions. Exports to India reached a value of £196,740, to China £49,960, South America £30,457, the Netherlands £25,820, Japan £18,516, France £16,459, the United States £14,421, Germany £12,094, and Australia £9635. Aggregate shipments to "other European countries" were valued at £86,985, compared with £79,172 in the corresponding month of last year.

Better Order Books.

Indications of improved order books were referred to by Alderman W. Davidson at the annual meeting of Tweedales and Smalley (1920), Ltd., textile machinery manufacturers, of Castleton, near Rochdale. Mr. Davidson said the company had every reason to be satisfied with their trade during the past financial year, and they had started the present year with an order book well in advance of the whole of the business carried out in the previous twelve months. They had been obliged to book orders, both in the home and foreign markets, on a credit basis, and so far the risks they had taken had been justified. As this credit was a new departure for the company, they had created reserves against the amount of machinery delivered on that basis.

The Manufacture of Canning Machinery.

It has been reported here during the past week that Mather and Platt, Ltd., of Park Works, Newton Heath, Manchester, who recently embarked upon the manufacture of machinery for the canning industries, have entered into an agreement with an American concern, the Food Manufacturers' Corporation, and that a selling organisation in this country, Food Manufacturers (M. and P.), Ltd., is being formed. It is understood that the agreement has arisen out of the circumstance that the importation of American canning machinery into this country has been seriously affected by recent developments here, including the departure from the gold standard.

Industrial Results.

Among the financial results of Lancashire and Cheshire engineering firms published during the past week those of two companies may be regarded as satisfactory. In the case of Ward and Goldstone, Ltd., Pendleton, Manchester, manufacturers of electrical cable and accessories, the net profits for the twelve months ending March were £9838, compared with £10,726 in 1930–31, and a dividend of 7 per cent. on the ordinary share capital is repeated. Mirrlees, Bickerton and Day, Ltd., oil engine makers, Stockport, report net profits of £7289, against £4246 in the previous year, and a dividend of 2½ per cent. is being paid, no distribution having been made a year ago. Larmuth and Bulmer, Ltd., engineers, Salford, sustained a total loss for the year to the end of March of £10,318. This compares with a profit in the previous year of £161.

Reorganisation of Capital.

In the Manchester Chancery Court on Monday, the Vice-chancellor, Mr. G. Courthope Wilson, K.C., confirmed a proposal by Kendall and Gent (1920), Ltd., machine tool makers, of Victoria Works, Gorton, Manchester, to reduce its share capital from £150,000 in £1 shares to £63,330 6s. 8d. by cancelling 13s. 4d. per share on 130,000 shares issued and fully paid and reducing them to 6s. 8d. The unissued shares will be subdivided into 60,000 shares and 260,000 new shares will be created, making the capital £150,000 in 450,000 shares of 6s. 8d. each.

Non-ferrous Metals.

The tin section of the non-ferrous metals market during the past week continued to attract major interest. Following upon the failure on the London market reported a week ago, selling pressure in the tin section was very keen when dealing was resumed after the suspension of operations in the metal on the Exchange and values were forced down to very low levels. When offerings became less plentiful later on there was a favourable reaction, and prices, at the moment of writing, although about £2 per ton below those indicated a week ago, are appreciably higher than the lowest points touched during the past week. Copper is steadier on balance and values have improved to the extent of nearly £2 per ton for standard brands, although there has been no apparent improvement in the demand for the metal, either in this country or in the United States and on the Continent. Lead has

lost ground again after being reasonably steady a week ago, current quotations being about 10s. per ton lower, with buying interest from consumers still relatively quiet. The spelter market has likewise been slow, and prices are easier by about 7s. 6d. per ton.

Iron and Steel.

A little more activity has been experienced on the pig iron market here, and Midland makers have booked several more contracts extending over the next few months with Lancashire users, whilst aggregate deliveries are about maintained on the same scale as before. Plentiful offers of machinery scrap, however, continue to exercise a restraining influence upon the demand for pig iron. Prices are steady, with Staffordshire, Derbyshire and Cleveland No. 3 at 67s. per ton, Northants at 65s. 6d., Derbyshire forge iron at 62s., Scottish foundry at from 86s. to 87s., and West Coast hematite at about 81s. per ton, including delivery Manchester, or equal distance in each case. Bar iron prices are steady at £9 15s. per ton for Lancashire Crown bars, and £10 5s. for best quality material, but sales are on rather quiet lines. There is a prospect of more being done shortly in constructional steel material, but in most other branches of the steel trade prospects of improvement are not too bright at the moment. In special alloy steels, however, a moderate business has been reported during the past week.

BARROW-IN-FURNESS.

Hematite.

Production is still on the light side and below normal, but on the whole stocks are not being increased to any extent, and at some of the works they are being reduced slightly. The general tone is not bad, and there is a hope that business has got down to its lowest and any alteration will be for the better. There is an absence of booking of orders for forward delivery, customers just taking iron to meet their present requirements. It will be interesting from now on to watch the market and see what effect the new tariff on pig iron will have. Charcoal iron is not subject to the new tariff in view of the fact that none is now produced in this country. Up to a few years ago the only charcoal furnace was at Backbarrow, some 15 miles from Barrow, but those works are now producing a special iron, by other processes, which, by the way, is finding a steady market. Shipments overseas are still down, which points to the fact that foreign buyers are not in the market yet. When they do come this district should benefit very considerably.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Conditions.

ALTHOUGH the heavy branches of the local steel industry are rather depressed, a fair amount of trade is being done in special lines, such as motor car parts, steel strip, precision tools and safety razors. This sectional activity lends support to a belief that there will be a definite revival later in the year, and in some quarters this belief is expressed with a considerable amount of confidence. It is interesting to note that representations have been forwarded from Sheffield to the Government urging an extension of the amount of credit they are prepared to grant for orders of goods to be supplied to Russia. Valuable orders could be booked in Sheffield for steel and tools if local firms were in a position to meet the Russian credit terms, which they are unable to do at the present time without assistance.

Activity at the Works.

Interesting details concerning the activity at local works are contained in the monthly report, just issued, of the district organiser of the Iron and Steel Trades Federation. It is shown that two blast-furnaces are in operation at Park Gate, and three each at Lysaghts and Appleby (Lincolnshire). There were two Siemens furnaces operating at Brown Bayley's Steelworks, Sheffield; two furnaces at the Grimesthorpe plant of the English Steel Corporation; one at Jessops' works, Sheffield; three at Industrial Steels; one furnace being got ready in the Siemens department at John Brown and Co's works; two furnaces at Hadfield's; one furnace at Andrews'; six furnaces at the Templeborough plant of United Steel Companies, and one at that firm's Rotherham works; two furnaces at the works of Samuel Fox and Co.; five at Park Gate; six at Lysaghts'; four at Appleby. The report also shows that there has been little change in the crucible steel and electric furnaces departments. In the rolling mills section it may be mentioned that the Sheffield Forge mills are running better than a month ago; the sheet mills at Firth's are busy on stainless steel; the bar mill of Fox and Co. is working nearly full time; at Bakers' the tire department has just been restarted after three week's stoppage, and the forge department at Jessops' is busy on work for Russia.

Reorganisation Schemes.

Sheffield is particularly interested just now in Sir George May's scheme for reorganising the iron and steel trades, and some of the small firms are apprehensive of being compelled to amalgamate with larger works. Among the committees which will be set up will be one to deal with Sheffield special steels, and it is understood that the constitution of this Committee will include Sir Arthur Balfour, Mr. W. E. S. Patrickson (B. Hunstman, Ltd.), Mr. C. W. Kayser (Kayser, Ellison and Co., Ltd.), Mr. C. K. Everitt (Edgar Allen and Co., Ltd.), and Mr. A. J. Grant (Thomas Firth and John Brown, Ltd.). It is expected that the Sheffield Regional Sub-committee will lose no time in getting to work, but that it will take some months to report.

Tariff Increases.

Tariff changes recommended by the Import Duties Advisory Committee, including a 33⅓ per cent. duty on foreign pig iron, castings and spring steel, have come about as a result of representations from the trades concerned. The Sheffield Imports Committee, which represented the Sheffield trades concerned with the tariff question, submitted the cases of castings and spring steel to the Government Committee. The request was made that castings less than 1 cwt. and also spring steel should be included in the tariff list. These tariffs had been needed by the iron and steel trade, and it is believed they will react to the benefit of Sheffield.

University Mining Department.

The Department of Mining of the University of Sheffield has been extended and improved by the addition of new buildings, which have been formally opened by Mr. W. Benton Jones, chairman of the South Yorkshire Coal Owners' Association. The new buildings have been erected at a cost of nearly £30,000, towards which the Central Committee of the Miners' Welfare Fund has contributed £19,210, and the coal owners of South Yorkshire and North Derbyshire £5722. Provision is made for an improvement and extension of research work as well as the training of mining engineers. Included in the apparatus is means of determining the inflammability of coal dust, and of a general investigation of the coal dust problem. The general laboratory is fully equipped for instruction and experimental work on mine ventilation, mine lighting, mine rescue and signalling. There are numerous modern instruments for routine instructional purposes, research and ventilation surveying. The Mining Department of the University originated in 1884.

A Cutlery Problem.

There has been a resurrection of the old complaint about stainless steel cutlery, that the blades are not as sharp as those of old-fashioned cutlery. It arises from the expression of an opinion by Mr. T. Bolton, of the British Non-ferrous Metals Research Association, and as there are 200,000,000 Sheffield stainless knives in use at the present time the matter is of considerable importance. Dr. W. H. Hatfield, of the Brown-Firth Research Laboratories, points out that any stainless knife which does not cut well must have been used for years without sharpening. Stainless knives have exactly the same hardness as ordinary knives; they are scientifically ground to the ideal thickness; the edge is given a correctly determined geometrical shape; they do not stain, and they cut very efficiently. The trouble is that housewives, in carrying out the necessary operation of cleaning the ordinary knives, perform an operation which has a sharpening effect; in dealing with stainless knives they consider that as it is unnecessary to clean them in the old way, it is unnecessary to sharpen them.

Railway Contracts.

It is announced that the L. and M.S. Railway Company has placed a contract with Mr. T. H. Scarr, of Howden, for the construction of a new dumb lighter for use in Goole Docks; a contract with Vickers-Armstrongs' for the overhaul of the Barrow bucket hopper dredger "Piel," and the Barrow tugs "Cartmel" and "Furnace"; and a contract with a firm at Mansfield, Notts., for the reconstruction of bridge No. 4 at Rolleston-on-Dove.

Anti-flood and Sewage Schemes.

The Trent Catchment Board is proceeding without delay to put in hand the preparation of a comprehensive scheme of main river improvements. The Gainsborough Urban District Council, which made representations to the Board in regard to the condition of river banks at Gainsborough, has been assured that attention will be given to the requirements of the district. The Skegness Council has adopted a sewage scheme, the estimated cost of which is £29,200.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Trade Outlook.

SIGNS are not lacking of a probable improvement in the conditions of the iron and steel industry in the North of England. It may not be to a substantial extent, but it will be very encouraging if there is some slight change from the quiet state of things which have been experienced for some time past. The increased protection which has been given should pave the way for much improved business in the home market. The new import duty on pig iron is regarded as a long overdue step, but has been welcomed with satisfaction by producers in this area. There have been no local imports of pig iron from abroad for months past, and, of course, Indian pig iron, which is a formidable competitor in Scotland, will continue to be admitted duty free. But in other areas a fair amount of foreign iron has been imported, and this presumably will now cease with advantage to home producers. Local opinion seems to be that the benefits will mature slowly, as there are substantial stocks of iron in the country. Naturally, too, merchants will not welcome the stoppage of alternative sources of supply, since they are not allowed to handle much local iron, the makers dealing direct with consumers. However, the industry as a whole will benefit, and consumers are promised safeguards against exploitation.

Cleveland Iron Trade.

There is a much more cheerful tone in the Cleveland iron trade. Coastwise shipments are substantially heavier this month, and further expansion is looked for. Inquiries are more numerous, and there has been a little forward buying. The bulk of the output is going into immediate consumption at local works, chiefly at producers' own foundries and steel works. Output is now being fully absorbed. Makers continue to sell Cleveland iron in Scotland at specially low figures in order to cope with the keen competition of dealers in other irons, but to customers elsewhere fixed minimum rates stand:—No. 1 Cleveland foundry, 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; and No. 4 forge, 57s.

Hematite Pig Iron.

Further sales of East Coast hematite pig iron have been made to consumers in South Wales, and better business is anticipated in other directions, as effects of the tariff become manifest. But export sales are almost impossible, and some producers have big stocks to dispose of. Prices are now based on mixed numbers at 62s. 6d.

Iron-making Materials.

Business in the foreign ore trade is exceedingly quiet. Consumers have large stocks, and deliveries to take under running contracts. Best Rubio ore is nominal at 15s. c.i.f. Tees. Blast-furnace coke is abundant. Sellers are anxious to clear their heavy stocks, but are unwilling to accept less than the basis of good average qualities at 15s. 6d. delivered at the works.

Manufactured Iron and Steel.

The manufactured iron and steel trade reflects a slight improvement. Orders, however, are chiefly for small quantities. Sections engaged on the production of constructional steel keep busy, but other plants are operating at a fraction of their capacity, and additional specifications are urgently needed. Prices are firmly maintained.

The Coal Trade.

There has been a little more activity in the Northern coal trade this week. Foreign inquiry now shows signs of growing brisker. An inquiry is to hand from the Frederiksberg Gasworks, asking for tenders for the supply of 16,000 to 18,000 tons of screened or washed gas coals for shipment from the end of this month until January. The Oslo Gasworks' order for 20,000 tons of Durham coking coals and 10,000 tons of Durham gas coals has been completed at 13s. 4½d. for one lot of coking coals, from that figure to 14s. for the remaining lot, and at about 13s. 5d. for the gas coal. Some disappointment has been occasioned as a result of the Swedish authorities postponing their decision on the placing of the order for 180,000 tons of locomotive coal and 5000 tons of bunkers for the Swedish State Railways. It is still generally anticipated, however, that a substantial part of this order will be placed in this area, in spite of the keen competition of Polish producers. The Gothenburg Gasworks authorities are also in the market for the supply of 12,000 tons of best grade gas coal and 18,000 tons of good class coking unscreened or small coal, to be shipped in monthly quantities during September to February. The outlook in the coal trade is certainly improving, and the number of forward inquiries circulating is very gratifying. In the Northumberland steam coal trade demands are keeping to the recent levels, and as owners generally have curtailed production during the past few weeks, the available supplies are not in excess of requirements, with prices holding steadily at the schedule minimum. Best Northumberland steam coals are quoted at 13s. 6d., and seconds at 12s. to 12s. 6d. Prime Wear large are fully steady at 15s., and small firm at 12s. Tyne prime qualities are irregular, screened at 12s. 9d., and small scarce at 9s. The tone of the Durham gas coal section is rather brighter, though ample supplies are available and sellers cannot force any appreciation in prices. Best qualities are quoted at 14s. 6d., and secondary class 13s. to 13s. 6d. Trade in bunker coal is not brisk, but general requirements are sufficient to keep prices steady, best at 13s. 6d. to 13s. 9d., and good class seconds at 13s. to 13s. 3d. Durham coking unscreened and smalls are in ample supply at 12s. to 13s. 9d. The pressure for best gas coke remains light, but stocks are not excessive, with prices asked steady at 17s. 9d. Foundry coke makers are eager for orders. Stocks are large, and prices are easy for patent oven makes at 14s. Superior foundry coke is offered freely at 16s. and coke nuts at 16s. to 18s.

SCOTLAND.

(From our own Correspondent.)

Little Change.

THE trade position in Scotland has not altered during the past week. Inquiries for certain products are improving slightly, and there appears to be some hope that business with Canada and the Far East will soon show definite improvement. Much has been expected from tariffs, but it is, of course, recognised that time must elapse before adequate arrangements can be made to cover all requirements. Orders for new shipbuilding work are still lacking, but there is rather more doing in repair work.

Steel.

The demand for heavy steel is still slow, owing to the scarcity of specifications for shipbuilding material, but it is said that export inquiries have shown a tendency to broaden out. The decision to form a National Committee of the steel and iron trades, also subsidiary or district committees, with the object of reorganising or co-ordinating the entire industries in all branches, has created considerable interest. It is anticipated that thereby an impetus will be given to a movement which has grown in recent years towards consolidation in larger units.

Steel Sheets.

There has been some improvement in the demand for steel sheets, and the inquiry is considerably better. The improvement is mainly in connection with light black sheets, the heavy gauges being less prominent and galvanised descriptions somewhat neglected.

Tubes.

The position in the tube trade is rather better, and the associated steel works are practically in full operation.

Iron.

Business in bar iron is slow to improve. Makers anticipate an increase in the 33⅓ per cent. duty, which is not sufficient to prevent the importation of Belgian iron. Makers of re-rolled steel bars also expected a further degree of protection after the three months' period expires. The home price of re-rolled steel bars, which has been free for a considerable time, is again controlled, and the quotation is £6 10s. per ton. The export price is about £6 7s. 6d. per ton.

Pig Iron.

A certain amount of satisfaction has arisen over the imposition of a duty on imported pig iron. Since the depreciation of sterling Continental pig iron has been practically shut out, but in view of reports of reduced prices, there appears to be some doubt as to the adequacy of a 33⅓ per cent. duty. For a time now there have been heavy imports of pig iron from India, and a further cargo of 2500 tons arrived last week, along with 450 tons of steel bars. Meanwhile, the output from the six furnaces in operation locally is in no wise stretched.

Scrap.

Scrap material is very difficult to move at present, and though prices are nominally unchanged at 47s. 6d. for cast iron machinery and 37s. 6d. heavy steel, the tendency is easier.

Coal.

Fifeshire steams, especially first qualities, are the firm features of the market at present, while treble nuts in the same district also continue strong. All other fuels are easily obtainable for prompt delivery. Foreign inquiries are still few and of small bulk, and shipments are mainly coastwise. Aggregate clearances during the past week amounted to 198,924 tons, of which only 69,500 tons went in foreign directions, compared with 229,494 tons in the preceding week and 177,292 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

THERE was an improvement in shipments of coal from this Channel last week, the total, according to the returns of the Great Western Railway Company, being 448,095 tons, which compared with 435,060 tons for the preceding week and with 485,413 tons for the corresponding period of last year. As a matter of fact, the returns for the ports of Newport and Port Talbot were the best for a long time past, but the increases for those two ports were rather offset by the figures for Cardiff. Still, it was no surprise that the aggregate for the whole of South Wales should be better, as quite a number of collieries were able to work rather more regularly than had been their experience earlier. Since then chartering operations have been moderately active, but whether the recent activity is going to be maintained is a little difficult to say. Outward rates of freight have of late been stronger, but with so much coal on the Continent, foreign buyers are not prepared to pay substantially higher prices for their requirements from this area. There is a limit to which they will go to obtain British coals, and it is for this reason that one is forced to believe that expansion in the coal export trade must be a slow process. A week ago the fact was mentioned that there were new orders in the market for prompt cargoes. Since then a number of them have been worked off by the chartering of tonnage, but it is questionable whether the flow of fresh orders is being maintained. The higher c.i.f. prices which are being quoted are, in all probability, causing foreign buyers to hold off, temporarily, at least. Still, the outlook is regarded hopefully. Mr. John Powell, the chairman of the South Wales Coal Exporters' Association, addressing a gathering of foreign journalists in connection with Civic Week at Cardiff, stated, on Saturday last, that in five years' time the industrial valleys of South Wales will again be humming with activity as the result of research and developments now taking place. Then, again, there are hopes of important developments arising from the experiments conducted on the Cunard liner "Scythia" in the utilisation of pulverised coal in conjunction with oil for the fuelling of ships. The prospects of thus opening up a new market for British coal is being discussed, though necessarily it must be some time before this comes about on any scale. The placing of a tariff of 33⅓ per cent. immediately on imports of pig iron has been well received in this area, as being helpful to the iron and steel industry and likely to substantially increase the demand for coals.

Coal Contracts, &c.

Though not officially confirmed, it is understood that the Paris Orleans Railway of France has purchased round about 100,000 tons of large coal from this district for delivery over 1933 and 1934. The Palestine Railways are also in the market for 6000 to 7000 tons of large Welsh coal, and the Newport Electricity Works have asked for prices of 20,000 tons of smalls for delivery over six months, or 40,000 tons over twelve months. The Norwegian State Railways have asked for prices for 18,000 tons of large coal, though it is expected that the greater part of this order will go to North Country coals. The Madrid, Zaragossa and Alicante Railway of Spain is inquiring for prices for 20,000 tons of coal from this district to be delivered at the usual Spanish depôts during the next few months. Alternative prices for double the quantity of coals are also asked for. With regard to the recent tenders for 60,000 tons of patent fuel for the Algerian State Railways, there is a prospect of a substantial proportion of this order coming to British Briquettes, Ltd., for Welsh fuel. This order is subject to confirmation, but it is also satisfactory to note that later on prices will be asked for by these railways for prices for 250,000 tons of patent fuel for delivery over the whole of next year. Some uneasiness is felt regarding the position respecting supplies of Welsh coals for the Italian State Railways, and the report is current that the Italian Government intends closing down the Cardiff office of the Italian State Railways. Mention was made of the fact that some time ago the Italian railways were not taking the supplies of coal arranged for under the Hague Agreement, which provided for one million tons annually for three years. There is still a million tons to be fixed up, but it is reported that the Italian Government has taken umbrage at the harm done to Italian trade by the imposition of tariffs, and that it is their intention to use the present position as an instrument for negotiations. Rumours have been current lately of France allocating greater quantities of her coal requirements to this country, but really there is no alteration from what was known a fortnight ago. The position is that the import quota for British coals to the end of this month is on the basis of 50 per cent. of the average monthly quantities shipped during 1928–30, plus 152,000 tons which have been allocated to the French Maritime Chambers of Commerce for British coals. On the question of the control of French coal import licences, there was a conference in London last week between representatives of the French coal Importers' Association and representatives of British colliery owners and exporters. The feeling of the British representatives was that for the present the existing system of control should not be altered, but if the French importers could submit a proposal for the setting up of a committee in Paris representative of all the interests in France and with representatives on it from this side, then the Mining Association of Great Britain and the British Coal Exporters' Association would give such proposal their careful consideration.

New Coal-loading Appliance.

Last week a new movable hoist, with ancillary wagon traversing platforms, capable of shipping coal from 20-ton wagons, came into operation at the Bute Docks, Cardiff. This forms the last of a battery of five appliances of this description which have been erected by the Great Western Railway Company at the Queen Alexandra Docks. Each of the five new hoists is capable of shipping coal from 20-ton wagons at a rate of 800 tons per hour. These hoists are of the latest type and contain all modern improvements, being fitted with escalator type of anti-breakage appliances. Being movable they can ship coal into any part of the ship without the vessel having to move in its berth. The hoists are worked by hydraulic power, whilst the traversers which convey the wagons from the feed roads to the shipping point are electrically operated.

Coalfield Items.

Last week the executive of the South Wales Miners' Federation gave approval to the agenda for the special conference of delegates to be held at Cardiff on Saturday. One resolution recommended by the Council expresses deep disappointment at the failure to secure the seven hours day and an improvement in the low wages now paid in the mining industry, and repeats the determination to prepare the organisation during the next twelve months to deal with the conditions that will arise in 1933. In the meantime, the M.F.G.B. is to be urged to take every step to inform all sections of the community of the conditions prevailing in the industry with a view to establishing by law minimum wages not less than 1914 wages, plus the increase in the cost of living; the ratification of the Geneva Conference on hours in coal mines; the strengthening of the National Industrial Board so as to secure the national regulation of wages and improving Part 1 of the 1930 Act so as to increase the revenue of the industry by eliminating competition between districts; the enforcement of a levy to assist export trade as a means for securing the international control of the production and distribution of coal. Owing to the depressed condition of trade the position of some colliery undertakings is very unfavourable. It became known at the end of last week that the Powell Duffryn Company was reducing the working at the Penallta Colliery, Ystrad Mynach, and the Ogilvie and Groesfaen collieries, Deri, near Bargoed, to a single shift instead of double. As a consequence, notices were being served on 2000 men, made up of about 1000 at the Penallta and something under 500 each at the Ogilvie and Groesfaen collieries.

Current Business.

The steam coal market displays no marked change. At the end of last week the loading position showed that there were forty-two vacant loading berths at the various ports throughout the Channel, but, as the result of week-end arrivals the number on Monday was reduced to thirty, with two steamers waiting at Swansea. On Tuesday the conditions were again less satisfactory, as the number of vacant berths was up to forty. The trouble with many collieries is that prompt tonnage is still rather scarce to meet the prompt orders that are available. Dry coals continue to be the steadiest section of the steam coal market, other descriptions of large and smalls being offered freely. Patent fuel is well stemmed, but coke at the moment is slow to move off. Pitwood remains comparatively quiet, with prices ranging from 19s. to 20s. 6d.

CONTRACTS.

A CONTRACT for sand-blasting and "Nusting" the steel work at Manor House Station on the Cockfosters extension of the Piccadilly Railway has been given to the Nor-Rust Liquid Lead Company, Ltd., London.

THE INTEGRA COMPANY, Ltd., Birmingham, informs us that the three open-hearth furnaces for the English Steel Corporation, Ltd., Sheffield, for which G. P. Wincott, Ltd., Sheffield, recently received a contract, will be equipped with the Leeds and Northrup automatic reversing equipment, for which the Integra Company, Ltd., is the sole British representative.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY, Ltd., has entered into an arrangement whereby Wild-Barfield Electric Furnaces, Ltd., will act as sole wholesale distributors of "Pyromic" 80/20 nickel-chromium and "Calomic" nickel-chromium-iron resistance alloys.

MAJOR RICHARD MILES, B.Sc. Eng., has resigned his position of general manager of the ironworks of Newton, Chambers and Co., Ltd., of Thorncliffe, near Sheffield, and local director of that firm, and accepted a position as director and general manager of Head, Wrightson and Co., Ltd., of Stockton-on-Tees.

A. C. WICKMAN, Ltd., Coventry, informs us that its associate company, The Tool Metal Manufacturing Company, Ltd., manufacturers in Great Britain of "Widia" brand tool metal, has changed its trade mark to "Wimet." This alteration, we understand, does not involve any change either in the process of manufacture or ownership of the patents.

HEAD, WRIGHTSON AND CO., Ltd., of Thornaby-on-Tees, announce that Mr. Malcolm Blair, who has held the position of general manager for twenty-one years and director for twelve years, is resigning his position as general manager in July next, but will retain his position as a part-time acting director of the company and its subsidiary companies.

CATALOGUES.

BRITISH INSULATED CABLES, Ltd., Prescot, Lancs.—An illustrated brochure of A.C. meters.

G. CARR AND SON, Ltd., 93 and 95, Rotherhithe-street, S.E.16.—A leaflet on chain and lifting gear.

STAVELEY COAL AND IRON COMPANY, Ltd., near Chesterfield.—June stock list of sand spun and cast iron pipes.

ALFA-LAVAL COMPANY, Ltd., 34, Grosvenor-road, S.W. 1.—Publication No. 11,070, on industrial centrifugal separators.

STANTON IRONWORKS COMPANY, Ltd., near Nottingham.—Particulars of spun iron pipes, their sizes and manufacture.

JOSHUA HEAP AND CO., Ltd., Ashton-under-Lyne.—Illustrated folder of automatic screwing machines with tangential dies.

HARLAND ENGINEERING COMPANY, Ltd., 72, Victoria-street, S.W. 1.—Leaflets on type "W" oil circuit breakers, kiosk sub-stations, and current transformers.

WM. ASQUITH, Ltd., Highroad Well Works, Halifax.—A sectionalised catalogue of the firm's products which include drilling and boring machines of all types.

J. POHLIG A.-G., Cologne, Germany.—"English General Prospectus No. 3111 E"; "Special Catalogue on Bi-cable Ropeways, No. 3108"; "Special Catalogue on Mono-cable Ropeways, No. 3201," copies of which can be obtained in this country from C. M. Hill and Co., Coventry House, E.C. 2.

TANGYES Ltd., Cornwall Works, Birmingham.—Copies of the following:—List No. 437, low-compression cold-starting heavy-oil engine; List No. 440, new horizontal heavy-oil engine; List No. 436, cold-starting airless injection vertical heavy-oil engine; List No. 432, vertical treble ram pumps; List No. 438, 4-ton transport screw jack; List No. 439, self-contained air compressor sets.

IMPORT DUTIES ADVISORY COMMITTEE.—The Import Duties Advisory Committee give notice that they have under consideration the question of recommending that the existing temporary additional duty on iron and steel products, which expires on July 25th next, should be continued for a further limited period. The present duty was imposed for an initial period of three months by the Additional Import Duties (No. 1) Order, 1932 (Schedule II.), and certain additions and amendments were recently made by the Additional Import Duties (No. 2) Order, 1932. In their first report the Committee contemplated that the temporary duty would be continued, subject to any necessary variations, until they were in a position to submit proposals of a more permanent character, and it is now clear that they will not be in a position to submit such proposals before the expiration of the current period of three months. Any representations which interested parties may desire to make in regard to extending the period of the existing temporary tariff should be addressed in writing to the Secretary, Import Duties Advisory Committee, Caxton House (West Block), Tothill-street, Westminster, S.W. 1, and should be received at that address not later than Tuesday, June 28th.

CONSULTING ENGINEERS AND CORPORATE PUBLICITY.—At the annual general meeting of the Association of Consulting Engineers on May 30th, the chairman, Mr. S. C. Lewis, directed the attention of members to the recommendations of a special sub-committee:—(1) That the time has come for this Association in its corporate capacity to take further steps to make the profession of the Consulting Engineer better known to the public; (2) that as a first step, a standing notice about the Association, somewhat on the lines of that issued by the Surveyors' Institution, should be inserted in suitable papers and publications, to appear at regular intervals. He added that the Association did not desire to take any action on those recommendations without the agreement of the Institution of Civil Engineers. In the discussion which followed, Mr. A. H. Dykes said that the root of the trouble lay in the lack of knowledge by the financial corporations, laymen, and others of the functions and duties of a *bond fide* independent Consulting Engineer, and that the public needed educating so that it would realise the benefits of employing the Consulting Engineer. Mr. J. S. Alford appealed for a perfectly free hand to deal with the question of corporate advertising, if it was found that agreement could not be reached with the Institution of Civil Engineers; he was supported by Mr. W. J. Halcrow.

THE REINFORCED CONCRETE ASSOCIATION.—The Reinforced Concrete Association, which represents the interests concerned in the reinforced concrete industry, has been incorporated and is now open to membership. Its objects are "to uphold a standard of excellence in the design and construction of reinforced concrete, and to promote its use." Its membership embraces engineers who design reinforced concrete buildings, bridges, and other structures, contractors who build them, and manufacturers who supply the materials which are used in their construction, and the Association already includes in its membership engineering concerns responsible for a large proportion of the reinforced concrete work which has been carried out in this country. It is therefore able to speak with unassailable authority upon all matters relating to reinforced concrete and its uses and is well equipped to deal with the many tasks which lie before it. The Council comprises Messrs. A. Kirkwood Dodds (Mouchel and Partners, Ltd.), D. H. Green (Trussed Concrete Steel Company, Ltd.), H. E. Steinberg (Considere Constructions, Ltd.), B. Taylor (Johnson's Reinforced Concrete Engineering Company, Ltd.), R. W. Vawdrey (Indented Bar and Concrete Engineering Company, Ltd.), J. B. Walters (British Reinforced Concrete Engineering Company, Ltd.), G. C. Workman (Edmond Coignet, Ltd.), G. M. Burt (John Mowlem and Co., Ltd.), H. H. D. Anderson (Associated Portland Cement Manufacturers, Ltd.). The office is at 20, Dartmouth-street, S.W. 1, and Mr. R. V. Chate is the secretary.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/6 to 20/–
(1) Spanish	17/– to 22/6
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	15/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 2 6	3 2 6
No. 1	3 3 0	3 3 0
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*)	—
	4 0 6 (*b*)	—
	4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 0 0 to 9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 10 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	10 15 0	10 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 10 0 to 8 12 6	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 5 0 to 7 15 0	—
Small Re-rolled Bars	6 7 6 to 6 10 0	—
Billets and Sheet Bars	4 17 6 to 5 7 6	—
Galv. Sheets, f.o.b. L'pool	9 5 0 to 9 7 6	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 7 6 to 8 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	14/9 to 15/3
Block Tin (cash)	113 5 0
„ (three months)	115 10 0
Copper (cash)	27 2 6
„ (three months)	27 0 0
Spanish Lead (cash)	9 5 0
„ „ (three months)	9 13 9
Spelter (cash)	11 8 9
„ (three months)	11 16 3
MANCHESTER—	
Copper, Best Selected Ingots	31 10 0
„ Electrolytic	32 10 0
„ Strong Sheets	59 0 0
„ Tubes (Basis Price), lb.	0 0 9½
Brass Tubes (Basis Price), lb.	0 0 8½
„ Condenser, lb.	0 0 11
Lead, English	11 10 0
„ Foreign	9 17 6
Spelter	11 12 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/3½ per lb.	
Ferro Tungsten	2/– per lb.	
Ferro Chrome, 4 p.c to 6 p.c. carbon	£25 0 0	7/6
„ „ 6 p.c. to 8 p.c.	£24 10 0	7/–
„ „ 8 p.c. to 10 p.c.	£23 15 0	7/–
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£37 10 0	12/–
„ „ „ 1 p.c. carbon	£47 2 6	14/–
„ „ „ 0·70 p.c. carbon	£52 0 0	14/–
„ „ „ carbon free	1/1 per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/– per unit	
„ „ 75 p.c.	£19 0 0 scale 7/– per unit	
„ Vanadium	12/6 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£250 to £255	
Ferro Cobalt	8/9 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/–
„ „ Ell	14/3
„ „ Splint	14/3 to 15/6
„ „ Trebles	11/6
„ „ Doubles	9/9
„ „ Singles	8/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	12/–
„ „ Jewel	16/6
„ „ Trebles	12/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	10/9 to 13/–
Screened Navigation	16/6
Trebles	13/6 to 14/9
Doubles	10/6 to 11/3
Singles	8/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	11/– to 11/6
Secondary Steam	11/–
Trebles	12/6 to 13/–
Doubles	10/6 to 11/–
Singles	8/9

(8) N.W. COAST— ENGLAND.

Steams	21/9
Household	32/6 to 51/8
Coke	20/– to 22/6
NORTHUMBERLAND—	
Best Steams	13/6
Second Steams	12/3 to 12/6
Steam Smalls	8/6
Unscreened	12/6 to 13/–
Household	27/– to 39/–
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/– to 37/–
Foundry Coke	24/–

SHEFFIELD—	Inland.	Export.
Best Hand-picked Branch	25/– to 26/–	—
South Yorkshire Best	20/– to 21/–	—
Derbyshire Best Bright House	20/– to 21/–	—
Screened House Coal	16/– to 17/6	—
Best Screened Nuts	16/– to 17/–	—
Small Screened Nuts	13/6 to 15/6	—
Yorkshire Hards	16/– to 18/–	—
Derbyshire Hards	16/– to 18/–	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	7/– to 8/6	—
Smalls	4/6 to 5/6	—
Blast-furnace Coke (Inland)	11/– to 12/– on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b., 14/6 to 16/6		

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/– to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/–
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/– to 13/6
Ordinary Smalls	11/– to 13/–
Washed Nuts	19/– to 25/–
No. 3 Rhondda Large	19/6 to 19/9
„ „ Smalls	15/– to 16/–
No. 2 „ Large	17/– to 17/3
„ „ Through	15/6 to 16/–
„ „ Smalls	14/– to 14/3
Foundry Coke (Export)	22/6 to 26/6
Furnace Coke (Export)	17/– to 18/–
Patent Fuel	19/– to 20/–
Pitwood (ex ship)	19/– to 20/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	36/– to 38/6
Seconds	27/– to 32/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 48/6
Nuts	40/– to 48/6
Beans	28/6 to 32/6
Peas	19/6 to 21/–
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/–
Steam Coals:	
Large	20/– to 20/6
Seconds	18/– to 20/–
Smalls	11/6 to 13/–
Cargo Through	16/– to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/– if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Trade and Finance.

At a time when money is required to carry out works that may relieve the industrial decline and prevent, for the time being, its rapid acceleration, it is becoming increasingly difficult to get financial assistance of any kind, and manufacturers have even lost hope of benefiting from the programme of public works which was to be put in hand with money raised by a special issue of Treasury Bonds. Most of that money has been utilised to pay for work already done, and much of the remainder will be devoted to administrative and State undertakings and particularly works of national defence. In the present condition of affairs those firms which depend for activity on armaments are usually well employed. Otherwise the situation has not been improved by the necessity of adopting severe measures to retrieve the national finances, and while the Government aims at a policy of economy and retrenchment there is a fear that additional burdens will be imposed on industry at a time when it has become absolutely imperative to remove them. Everyone is of the opinion that wages must be reduced all round, but this course may cause trouble, at a time when the cost of living continues to increase. No money is available for industrial enterprise when profits are dwindling and disappearing and giving way, in many cases, to serious losses and when the railway traffic receipts, which are regarded as an indication of industrial and commercial activity, show a drop, between January 1st and May 26th, of more than 971 million francs, as compared with the corresponding period of 1931. All internal organisation has failed to avert the exceptionally serious depression, and nothing further can be done except by an international organisation which may follow upon the forthcoming conferences. This change of front has been forced upon the French by the British fiscal policy, and the new duty of 33⅓ per cent. on raw iron imported into Great Britain has given the finishing touch to a very unpleasant situation. Matters have now reached a point where the French must pull with other countries in an effort to turn the corner.

Art and Engineering.

The annual exhibition of decorative arts in Paris shows that the architect has become an artist and that engineering is increasingly identified with the utilitarian side of art. The tunnel of an underground railway does not seem to lend itself to artistic treatment, and yet there is a design for a tunnel with a glass lining for diffused lighting that may possibly give train passengers an illusion that they are travelling through illuminated space. The glass maker will appreciate some of these modern developments if the experiments with glass buildings should prove successful. In one exhibit a table is made of a very thick plate of rough-edged glass supported on piles of small similar slabs. Ideas are diverging to extremes, for while some designers get the maximum of light by glass construction which would seem to dispel all sense of privacy, others dispense with glass altogether and propose to build houses without windows and install on the roof a reflector that will turn with the sun and, by an internal arrangement of reflectors, flood the whole of the inside from the top floor to the cellar with sunshine, when there is any. For the moment the use of glass in construction is extending in a way that shows the importance attached by architects to getting as much daylight inside as possible, and in all the new works and factories more glass is used than ever before. Another application of art to engineering is a colossal lighthouse which it is proposed to erect, as a monument to French genius, at the end of the avenue extending for miles from the Place de la Concorde to the heights of Courbevoie.

A Suspension Bridge.

The longest suspension bridge in France has just been completed at Cavaillon over the river Durance in the Dordogne, where it replaces an old bridge which had been washed away by floods. The piers of the old bridge were in the bed of the river. The massive pylons of the new bridge are of reinforced concrete, 42 m. high, are built on the banks and provide a span of 308 m. The platform, which is 8 m. wide, is supported by thirty-two cables of 10 cm. diameter and 450 m. long. The bridge was constructed by the Société Fives-Lille.

Railway Speeds.

There is to be an acceleration of certain trains during the summer, notably between Paris and Rouen, for which journey the time will be reduced to 1 h. 24 min. representing an average speed of 61·8 miles an hour. On the Nord, the Paris-Berlin *rapide* will reach Saint-Quentin in 1 h. 25 min. at an average speed of 67 miles an hour and the Belgian frontier—148·8 miles—in 2 h. 15 min., representing an average of 66 miles an hour. The speed on French railways is limited to 74½ miles an hour.

Ocean Liners.

The reorganisation of the Compagnie Générale Transatlantique under State control is giving a more definite trend to its future policy, and it may be said that the new liner "Champlain," which will make her maiden voyage from Havre to New York this month, indicates the manner in which the French hope to deal successfully with the economic difficulties arising out of the competition for traffic. Like the "Georges Philippar," the new Transatlantic liner is a compromise between the old vessels that lacked speed and the new floating palaces in which speed is increased at undue cost. The "Champlain" is designed to steam at a maximum of slightly below 21 knots and is built to accommodate 643 first-class passengers, 218 tourists, and 122 third-class passengers. French designers attach much importance to internal decoration and conveniences for all classes of passengers as a means of making the ships popular. The "Champlain" has a length of 195·7 m., a width of 26·1 m., and a displacement of 28,000 tons. It is probable that the big liner to be launched at Saint-Nazaire in the autumn will be the last of the huge vessels built for the sake of national prestige. The losses incurred in running such ships are so heavy that the French will be satisfied, for a long time to come at least, with the prestige which will accrue from the liner now nearing completion in the Penhoët shipyard.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

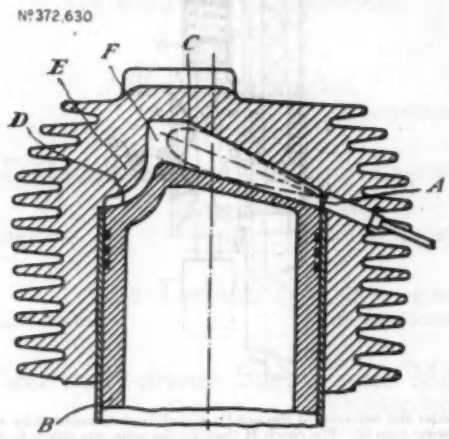
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

372,630. July 23rd, 1931.—Combustion Chambers, Siemens and Halske Aktien-Gesellschaft, Berlin-Siemensstadt, Germany.

In the drawing A indicates the fuel jet. The piston B has a projection C positioned symmetrically to the longitudinal axis of the piston. This projection inclines upwards in wedge shape from the circumference of the piston and extends to beyond its central axis, where the top surface of the projection ends in approximately the form of an arc and falls off in a cylindrical or similar surface. The projection C leaves an annular part D

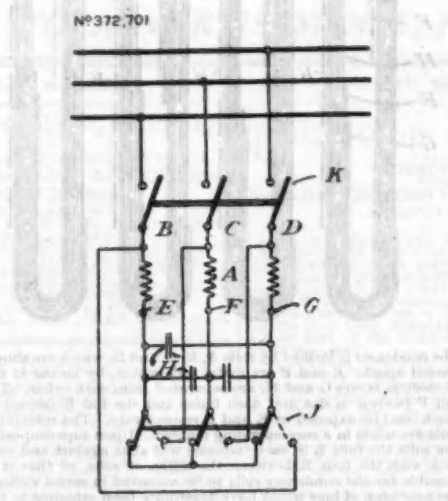


of the piston free. The inner top part of the cylinder head contains a projecting part E corresponding to the annular recess and a conical or pyramidical recess F, adapted to the shape of the fuel jet, the vertex of the conical or pyramidical recess being directed towards the opening of the nozzle A. In this manner a combustion space corresponding exactly to the shape of the fuel jet is obtained. The central axis of the combustion space forms an acute angle with the axis of the cylinder, whereby a length of the combustion space is obtained which corresponds to the penetrating force of the fuel jet.—*May 12th, 1932.*

DYNAMOS AND MOTORS.

372,701. November 27th, 1931.—The Control of Multiphase Electric Motors Associated with Condensers, *International General Electric Company, Inc., of* 120, *Broadway, New York, U.S.A.*

The invention relates to three-phase current motors, of which the inductive wattless consumption is compensated to a certain degree by condensers connected in parallel, and which are started by means of star-delta switches. In case of the known connections of this kind, the condensers which are mostly in three-phase arrangement, and which can be in star or delta connection, are directly connected with the outer terminals of the stator winding of the motor, so that the condensers are connected or disconnected simultaneously with the motor. If the motor is started under these conditions, then with the change-over from

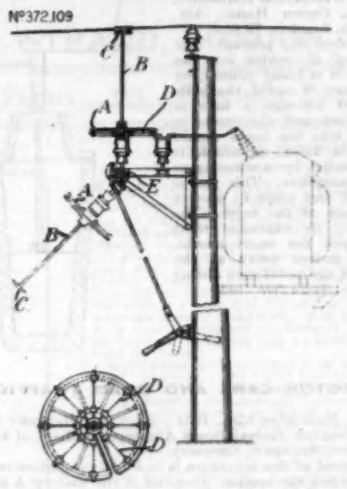


star to delta, considerable excess voltages may occur in the motor and condensers, and the object of the invention is to avoid these excess voltages. The motor A to be compensated for wattless is provided with supply terminals B C D. The other ends of the windings, which during the star connection are connected together to the neutral point, are represented by E F G. H are the condensers which are connected with these winding ends, and in the star connection are short-circuited by the neutral point connections through the switch J. K is the switch for disconnecting the motor from the supply. The arrangement is such that the delta connections of the stator windings are not interrupted with the cutting-out of the motor. The switches K and J can also be combined into a single switch.—*May 12th, 1932.*

SWITCHGEAR.

372,109. May 19th, 1931.—Magazine Switch Fuses, The English Electric Company, Ltd., of Queen's House, 28, Kingsway, London, W.C. 2, and Cornelius Hollander, of Siemens Works, Stafford.

This specification describes a magazine switch fuse suitable for tapping an overhead line. The circular fuse carrier A is

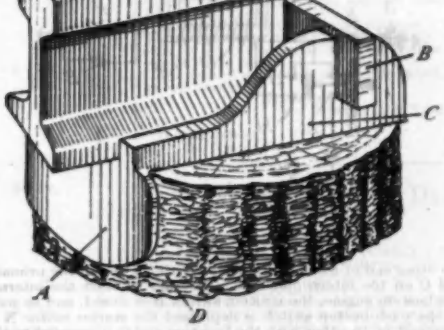


carried on a switch arm B with a spherical head C, which makes contact with the line. Fuses D are arranged on the underside of the carrier A. By means of a ratchet E the fuse carrier is made to rotate on opening and closing the switch and a new fuse is inserted in the circuit.—*May 5th, 1932.*

MINING MACHINERY.

372,605. June 25th, 1931.—Roof Supports for Mines, Peter Thielmann, Silschede, Westfalen, Germany, and W. Peyinghaus, trading as Eisen und Stahlwerk Walter Peyinghaus, Egge bei Volmarstein/Ruhr, Germany.

A cramp iron A transmits the earth pressure through the

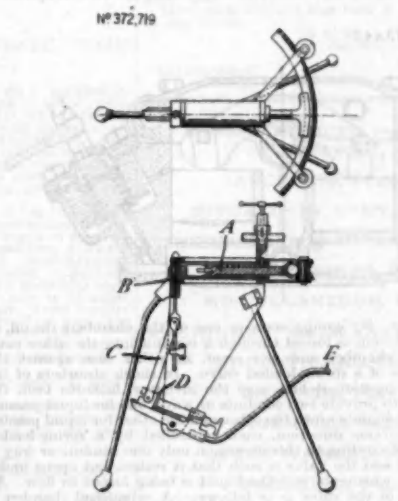


bar B and the cap C to the side props D. Should the earth pressure be excessive, it will merely bend the bar B and not injure the cap itself.—*May 12th, 1932.*

MACHINE TOOLS AND SHOP APPLIANCES.

372,719. February 16th, 1932.—Pipe-bending Machines, M. Petitiaux, 16, Rue Notre-Dame, Toulouse, France.

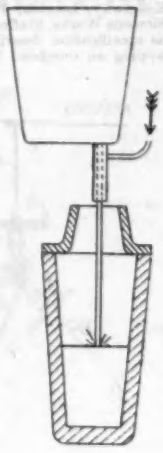
This pipe bender is worked hydraulically by means of the



ram A. In order to secure a variable mechanical advantage, according to the work in hand, the pump B is operated through a linkage C, which embodies a sliding block D for altering the leverage of the handle E.—*May 12th, 1932.*

METALLURGY.

No 371,880



371,880. January 26th, 1931.—CASTING INGOTS, R. W. Bailey, 20, Grange-avenue, Hale, Chester, and Associated Electrical Industries, Ltd., Crown House, Aldwych, London, W.C. 2.

In order to prevent the entraining of oxides into an ingot, as it is being poured, by the stream of metal, the ladle is tapped through a hole in the bottom and the metal is dropped into the ingot mould through a tube, in which it is surrounded by a reducing or inert atmosphere. This gas is entrained and helps to protect the surface of the ingot. The tube may be extended right down into the ingot mould, and be melted away as the surface of the metal rises during pouring.—*April 26th*, 1932.

MOTOR CARS AND ROAD TRAFFIC.

373,065. November 17th, 1931.—ELECTRIC BATTERY IGNITION APPARATUS, Robert Bosch Aktiengesellschaft, of 4, Militärstrasse, Stuttgart, Germany.

The object of this invention is to improve ignition conditions when starting the engine. One end of the battery A is earthed and the other end is connected to one terminal of the ignition switch B, which is connected to one end of a primary coil C and of the high-tension winding D of an ignition coil. A condenser E is arranged in parallel to the interrupter F. The second end of the secondary coil is connected with the rotating arm of a distributor G. Between the ignition switch B and the ignition coil a conductor branches off to the contacts H J of a push-button switch K. These contacts stand opposite the contacts L M. Between the contact L and the earth is a starter motor N, and to the contact M the end of a coil O is connected,

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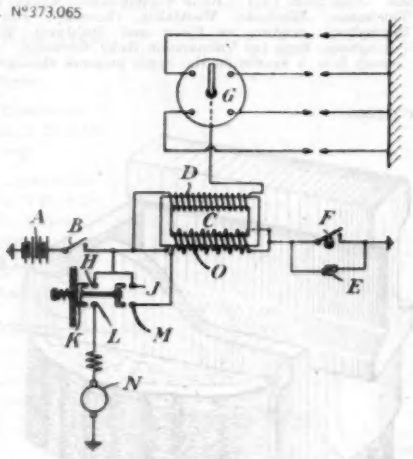

the other end of which is connected with the end of the primary coil C on the interrupter side. In order to start the internal combustion engine, the ignition switch B is closed, and as soon as the push-button switch is depressed the starter motor N is switched in, together with the boosting coil O in parallel to the primary coil C. Owing to the heavy current which is taken up by the starter, the voltage of the battery sinks considerably. In consequence of this, a primary coil C, if it is correctly proportioned for normal working conditions, would no longer produce satisfactory igniting sparks. By the parallel connection of the boosting coil, however, the number of ampère turns of the coil is increased, and a spark capable of producing ignition is produced.—*May 19th*, 1932.

372,445. February 24th, 1931.—SHOCK ABSORBERS, Sir F. H. Royce, Nightingale-road, Derby.

This invention has reference to hydraulic shock absorbers for cushioning the relative movement of members, such as the frame and axle of a road vehicle, in which there are two compression

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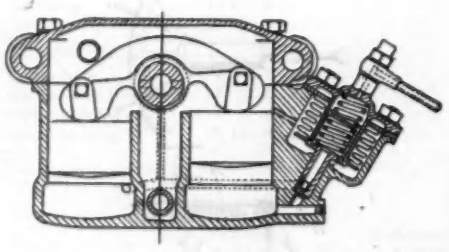

chambers. By compression in one of the chambers the oil, or liquid, therein is forced through a conduit into the other compression chamber and *vice versâ*, in either case against the resistance of a spring-loaded valve. In shock absorbers of the type in question it has, says the inventor, hitherto been the practice to provide two conduits or ways, one for liquid passing from one chamber into the other and the other for liquid passing in the reverse direction, each controlled by a spring-loaded valve. According to this invention only one conduit or way is provided and the valve is such that it resists, but opens under pressure, whichever way the liquid is being forced to flow. An example of the valve is as follows:—A cylindrical chamber is provided, the conduit from one of the compression chambers opens into one end of this cylindrical chamber and the conduit from the other compression chamber opens into the side of the said cylindrical chamber, a piston having two diameters slides in the said cylindrical chamber. When the piston is one end of the cylindrical chamber the smaller diameter part impinges upon and closes the opening of the first-mentioned conduit, while the other conduit opens into the annular space around the said smaller diameter part. A spring reacts between the other end of the cylindrical chamber and the piston to hold it normally against the orifice of the first-mentioned conduit. By differentiating the superficial areas of the part of the piston closing the orifice of the first-mentioned conduit and that of the larger diameter part forming one end of the said annular space any desired difference can be arranged between the pressure in one direction or the pressure in the other direction required to move the piston and open the valve.—*May 12th*, 1932.

MISCELLANEOUS.

372,595. June 17th, 1931.—MECHANISM FOR CONVERTING ROTARY INTO RECIPROCATING MOTION, M. C. Campbell-Wilson, Star Cottage, Morcombelake, Bridport, Dorset.

This mechanism is put forward as a means for operating such apparatus as wind-screen wipers on motor cars and is worked by the continuously rotating shaft A. This shaft has a right and left-hand thread, as shown, and works the wiper arm B through the two nuts C and D, the engaging tappet E, and the plates F F. When the wiper arm assembly moves in the direction of the arrow,

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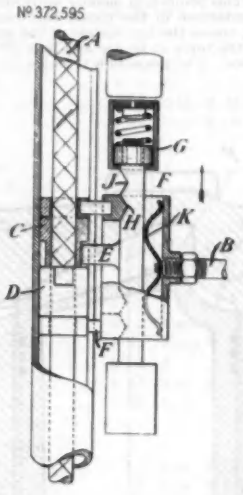
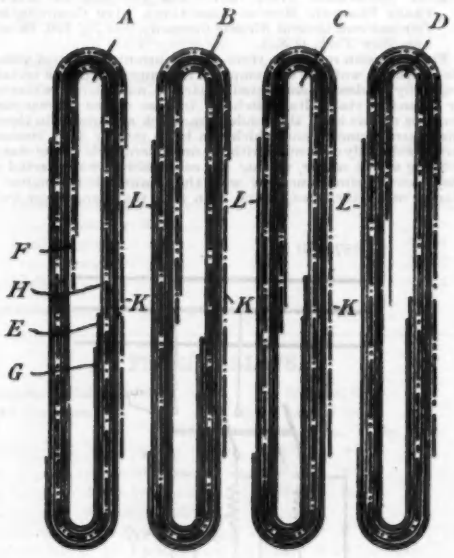


under the influence of the nut C, it is ultimately arrested by the spring stop G. The catch H then jumps from one notch to the other notch J, against the resistance of the spring K, and the stroke is reversed by the engagement of the nut D.—*May 12th*, 1932.

372,695. November 9th, 1931.—ELECTRIC ROLL TYPE CONDENSERS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

This invention has reference to electric roll type condensers. In roll type condensers difficulties arise in that the metal foils contained in the roll and forming the electrodes have to be connected to laterally arranged leads. Further, when mounting roll condensers in series, connections have hitherto been made to individual metal lugs, which have first to be mounted in series. According to the invention, the arrangement or mounting of roll type condensers in series is considerably simplified.

No 372,695



The condenser is formed by rolls A, B, C, and D, which are shown spaced apart. E and F are metal foils which, by means of the di-electric layers G and H, are separated from each other. The foil F (shown in dot and dash lines) and the foil E (shown in thick line) lie exposed at K and L respectively. The remaining rolls are made in a corresponding manner. Upon superimposing the rolls the foils L in each instance will abut against and contact with the foils K between the adjacent rolls, so that it is possible for the condenser rolls to be mounted in series without the provision of lugs which have heretofore been attached to the foils.—*May 12th*, 1932.

LAUNCHES AND TRIAL TRIPS.

BARON ARDROSSAN, steamer; built by David and William Henderson and Co., Ltd., to the order of Messrs. H. Hogarth and Sons, Glasgow; dimensions, 360ft. by 51ft. 6in. by 25ft.; to carry cargo. Engines, triple-expansion, 21½in. by 37in. by 52in. by 42in. stroke, pressure 210 lb. per square inch; constructed by the builders; trial trip, June 4th.

MOLDANGER, single-screw motor ship; built by the Netherland Shipbuilding Company, to the order of Messrs. Westfal-Larsen and Co. A/S, Bergen, Norway; dimensions, 486ft. by 61ft. by 39ft. 6in.; to carry cargo and a few passengers. Oil engines, A.E.G. type, installed on board by Messrs. Maschinefabriek Gebr. Stark and Co., Henlego; launch, June 4th.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

ILLUMINATING ENGINEERING SOCIETY.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. Annual general meeting, 6.30 for 7 p.m. Presidential address by Sir Francis Goodenough, 7.15 p.m.

INSTITUTION OF MINING ENGINEERS.—Summer meeting at Sheffield. Wednesday, general meeting at the Royal Victoria Hotel, Sheffield. Address of welcome by the Lord Mayor of Sheffield. Presentation and discussion of papers, 11 a.m. The meeting will be adjourned at 1 p.m. and resumed at 2.30 p.m. Reception of members and ladies by the Lord Mayor and the Lady Mayoress of Sheffield at the Town Hall, 4.30 p.m. Reception of members and ladies at the Royal Victoria Hotel, Sheffield, by the President and Council of the Midland Institute of Mining Engineers, followed by a cabaret show and dance, 8.30 p.m. Thursday, visits to various works, 10.30 a.m. Institution of Mining Engineers' dinner at the Royal Victoria Hotel, Sheffield, followed by informal dance, 7.30 p.m. Friday, visits to various works, 11 a.m.

PHYSICAL SOCIETY.—At the Imperial College of Science and Technology, Imperial Institute-road, South Kensington, S.W. 7. Editing Committee meeting, 3.30 p.m.; Council meeting, 4 p.m. Seventeenth Guthrie Lecture, "The Concept of Causality in Physics," by Professor MAX PLANCK. 5 p.m.

TO-DAY AND SATURDAY, JUNE 18TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Glasgow. Fifty-ninth annual general meeting and conference.

SATURDAY, JUNE 18TH.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.—In the Lecture Theatre of the Institute, Newcastle-upon-Tyne. The following papers will be open for further discussion:—"Newcomen and his Engine," by Mr. R. N. Appleby Miller; "The Firedamp Interferometer, an Optical Measuring Instrument for Determining the Methane Content of the Air Underground," by Dr. Fritz Loewe. The following paper will be read:—"Notes on a Few Unusual Occurrences of Inflammable and Noxious Gases in Mines," by Mr. A. M. Bryan. 2.30 p.m.

MONDAY TO WEDNESDAY, JUNE 20TH TO 22ND.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Summer meeting at Folkestone. Tuesday, Grand Hotel, Folkestone. "Heating Boiler Ratings," by Mr. Norman Wignall. 9.45 a.m.

TUESDAY TO SATURDAY, JUNE 21ST TO 25TH.

BRITISH WATERWORKS ASSOCIATION.—Bournemouth. Annual general meeting and conference. For programme see page 492.

WEDNESDAY, JUNE 22ND.

MANCHESTER ASSOCIATION OF ENGINEERS.—Visit to works of Alfred Herbert, Ltd., Coventry. Leave Manchester (London-road), 8.30 a.m.

FRIDAY, JUNE 24TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS: WEST MIDLAND DISTRICT.—Meeting at Stratford-on-Avon. Assemble at front entrance Shakespeare Memorial Theatre. 3 p.m.

SATURDAY, JUNE 25TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South-Eastern District, Junior Section, meeting at Canterbury. Assemble at Broad-street Car Park, Canterbury, 2.30 p.m.

FRIDAY, JULY 1ST.

OVERHEAD LINES ASSOCIATION.—Summer meeting at Chesham. For provisional programme see page 513.

SATURDAY, JULY 2ND.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—The annual picnic to Liverpool and New Brighton. Particulars from Mr. Ellis Flower.

DIESEL ENGINE USERS ASSOCIATION.—Summer Meeting. Visit to m.v. "Asturias" at Southampton. Presidential Address by Mr. C. M. Mayson.

MONDAY TO TUESDAY, JULY 4TH TO 12TH.

INTERNATIONAL ELECTRICAL CONGRESS, 1932.—Particulars may be obtained by intending British visitors from the Secretary of the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2.

TUESDAY, JULY 5TH, TO SATURDAY, JULY 9TH.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.—Royal Show at Southampton.

THURSDAY, JULY 7TH.

BRITISH ELECTRO-FARMING CONFERENCE.—Members' Tent, Show Yard, Royal Agricultural Society, Southampton. 3 p.m.

WEDNESDAY, AUGUST 31ST, TO WEDNESDAY, SEPTEMBER 7TH.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—Annual meeting at York. President, Sir J. Alfred Ewing, F.R.S. Particulars may be obtained on application to the secretary, British Association, or to the hon. local secretaries, British Association, The Guildhall, York.

SATURDAY, SEPTEMBER 24TH.

ALL-BRITISH EXHIBITION.—Copenhagen, Denmark. Opening.